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THE NERNST ELECTRIC LAMP.

Vague rumors, notes, etc., concerning the Nernst electrolytic lamp have already aroused the greatest interest among those electrical engineers in this country who appreciate the limitations of both the arc and incandescent lamp, and are sufficiently iconoclastic to believe that devices superior to both for translating electrical energy into light are likely to be invented. More definite information is now at hand, a discussion of the subject by Mr. James Swinburne being reprinted on other pages of this paper, from which the lamp appears to have a fair prospect of carrying out the rather extravagant promises of the first reports.

So accustomed have we become to the requirements of the arc and incandescent lamp, and so habituated to designing our systems to meet their exacting demands, that we do not realize what great room for improvement there is in these most vital and important features of electric lighting. As pointed out in the paper referred to, the carbon-filament lamp necessitates distribution at a pressure so low (110 to 125 volts) as to increase greatly the cost of electricity delivered, unless great sacrifices are made to double the voltage. The arc lamp is also by nature a low-voltage device, even worse in this respect than the incandescent, calling in general for series circuits with all their well-known disadvantages. The Nernst lamp can be made a high-voltage device, capable of being run singly on 500 volts, or even 1000 satisfactorily, in large candle powers. The substitution of a 1000-volt constant-potential alternating-current system of mains with single lamps connected straight across the lines without transformers, the whole fed from large alternators running in multiple, in place of the bothersome mess of series circuits, small machines, belting and countershafting of the central station of the present day, would be a great step forward. Add to this the substitution of a lamp without any regulating machinery whatever, requiring no trimming, and the central station manager's ideal of street lighting would seem to be found. In the features of quality of light and economy of current the Nernst lamp compares very closely with the arc lamp, the quality being given by our English contemporaries as somewhat more pleasing than that of the naked arc, and probably closely comparable with that of the enclosed arc with an opalescent globe. The economy is given at 1.5 watts per candle-power, practically the same as that of the enclosed arc when its globe is clean, and more than twice as good as any commercially obtainable with the carbon filament throughout its life.

Another requirement of the carbon-filament lamp that is very hard to meet is the necessary closeness of regulation. As to what the Nernst lamp will need in this respect there has as yet been no data published, but it is probable that it will offer no improvement. Trouble with the incandescent lamp is due to the fact that the light emitted is proportional, roughly, to the third power of the voltage, making any changes of the latter very perceptible, and also to the fact that it is worked at a temperature near that of destruction, so that any considerable rise destroys the lamp. The Nernst lamp, on the other hand, has, unfortunately, a high negative temperature coefficient, so that any rise in voltage lowers the resistance and causes a double change of energy emitted, aggravating the change of candle-power and making it, like the arc, quite unstable in parallel running. The lamps exhibited in England were provided with a series resistance for absorbing about 10 to 12 per cent. of the voltage to reduce this instability.

The greatest hindrance to the general use of the Nernst lamp at present is the difficulty of starting. The conducting and light-emitting rod, when cold, is an insulator and must be lighted with a match or some equivalent external electrical means, the latter requiring for the best effects mechanism for its removal when the rod becomes heated and conducting. The ideal remedy for this difficulty, and also for the instability mentioned above—could the proper material be found—would be the use of an auxiliary resistance with an extremely high temperature coefficient, such that the conductivity of the auxiliary resistance and the emissive substance would be practically independent of the temperature. The latter could then be arranged as a tube or sleeve around the former, the auxiliary taking current on starting, its temperature coefficient cutting down its current as that in the main substance rises with the heating. The combination would also render the lamp less unstable with voltage variations.

SOME NOTES ON THE PROPER SIZE OF STORAGE BATTERIES.

Now that it is generally admitted that the storage battery is a profitable auxiliary in electric power systems generating direct currents with a low load factor, a problem worthy of considerable thought is the proper size of the battery, or, to be more explicit, the proper ratio of the battery output to that of the generating machinery. At the last meeting of the American Institute of Electrical Engineers Mr. Robert McA. Lloyd presented a paper on "Storage Batteries and Railway Power Stations," a part of which will be found on another page, in which this problem is touched. Considering the case of a railway power station of a small or moderate size in which the load fluctuations are always quite violent, this paper discusses the relative advantages of three different sizes of battery, one sufficiently large to smooth out the momentary fluctuations, another sufficient to level the hourly variations and another sufficient to smooth down the daily peaks. The discussion brought out several points not noted in the paper. The chief factor of the cost of a battery is its depreciation, so that in general the lower the depreciation the larger is the battery that may be afforded for any given installation. But it also happens that the larger the battery the lower is its depreciation, owing to the fact that with the fluctuations and peaks of a given load on the battery the lower is its rate of charge and discharge per pound of material. It may be, and probably is, the fact that in general the use of a storage battery twice as large as those commonly accepted as a proper size in this country would cut down the depreciation more than 50 per cent., so that this main element of the total cost in the long run would be less, while the reserve capacity, regulation, efficiency and various other factors would be greatly improved. The users of storage batteries in this country have insisted upon a high discharge rate in order to cut down the investment per kilowatt output from the battery. The latter, therefore, is built now even for regular service at a one-hour discharge rate, but cannot be expected to show, with this heavy duty, as low a depreciation as the Europeans can obtain with their four to eight-hour maximum discharge rates. It is more than likely that, should American batteries for any given service be doubled, tripled or quadrupled in size—in order to give the same ampere hours per pound of plate and the same maximum discharge rate as that now considered proper in European service—that the depreciation would run down in even greater proportion from the 12 to 15 per cent. common in this country to the 3 or 4 per cent. of European batteries. Another factor enters in, and that is the fact that the lower the discharge rate the greater is the output of energy of the battery. For example, if a given battery heavily worked is duplicated, the load remaining the same, the double equipment will carry it for considerably more than double the time, owing to the reduced rate of discharge; in fact, a battery that will give, for example, 1000 amperes for one hour will give 200 amperes for ten hours before it arrives at the same degree of exhaustion, the output in the latter case being just twice as great. The difference is not, as most people suppose, internally wasted, the battery, when discharged at the higher rate, and consequently giving the smaller regular amount of energy, requiring an almost correspondingly smaller input to restore it to the charged condition.

With regard to the depreciation of storage batteries, there are two very essential differences from the depreciation of other electrical apparatus. The dynamo or engine requires from time to time new brushes, partial or complete rewinding, new brasses, perhaps a new commutator, renewal of the wearng parts or of some part broken, all these expenses being charged up against maintenance, a machine with these renewals, if properly cared for, remaining indefinitely in practically as good shape as when new. Some engineers have a vague idea of machines racking themselves to pieces, undergoing some sort of a cold crystallization, so that they will eventually follow the history of the "one-hoss shay," but the present condition of the earliest dynamos built, and of engines much older, seems to bear no corroboration of this theory. However, even if the machines remain entirely as good as new they must eventually be discarded, owing to the improvements in the state of the art. With the present increase in sizes and the promised revolutions due to superheated steam, the gas engine or the steam turbine, the useful life of apparatus can hardly be safely estimated at more than ten years, so that outside of the maintenance expenses described above there must be written off from the value of the apparatus about 10 per cent. per year for depreciation. The case of the storage battery is very different. Its depreciation calls for the renewal of its plates from time to time, perhaps in five years, perhaps in twenty-five; but once renewed, the battery becomes an up-to-date machine, since the new plates, of course, may be of the latest manufacture. There is, therefore, no occasion to write off any further percentage of the original cost for fear of the necessity of "scrapping" the battery, due to its out-of-date character.

The general trend of the discussion at the meeting above referred to showed the approval of a larger ratio of battery to engine power than that as yet authorized by custom, even to the extent of installing a battery with a considerably higher power rating at a one-hour discharge rate than the output of the generating capacity itself, or—looking at the matter from another point of view—a battery costing twice as much, or more, as the generating apparatus complete.

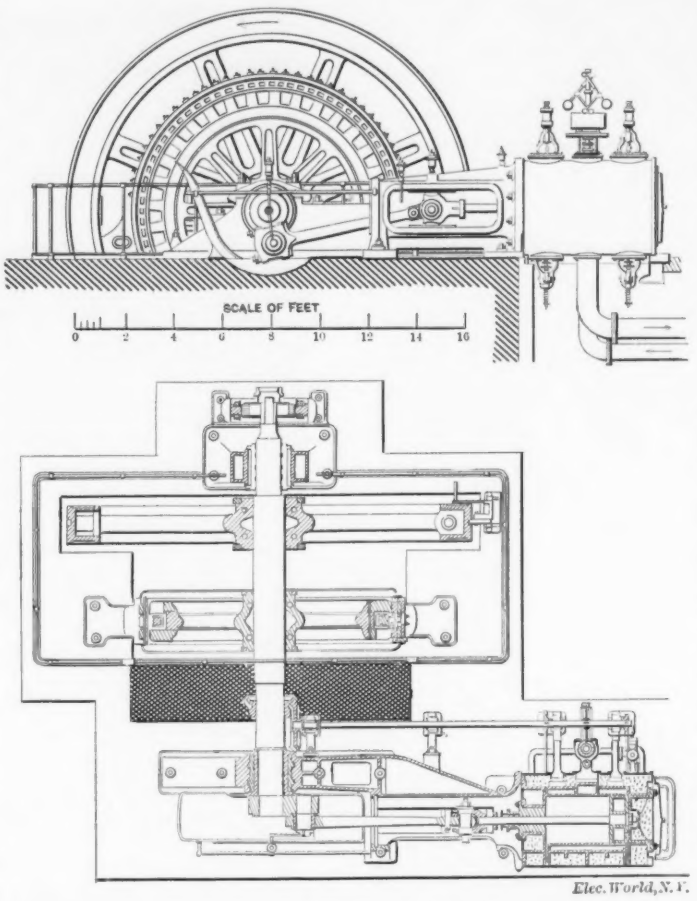
Insulation Against High Potentials.

Patent No. 619,360, issued February 14, 1899, to Charles P. Steinmetz, describes an interesting development in the art of eliminating occluded air from dielectrics intended to withstand extremely high potentials. In the construction of condensers, transformers, etc., for high-frequency currents or oscillatory discharges of very high tension it is customary to exhaust the air by a vacuum pump and fill the space with insulation melted and poured in. The organic materials customarily used, such as paraffin, occlude air with such tenacity that in spite of the vacuum sufficient air remains in the insulation to cause heating under the high-frequency alternations of electrostatic stress and ultimately to disrupt the dielectric. The improvement consists in filling the spaces first with a light liquid hydrocarbon, which readily penetrates all of the cavities, and is so chosen that it boils above the melting point of the permanent insulating material, but below the temperature at which the latter is applied. The hydrocarbon is then eliminated by heat or the vacuum pump, or both combined, carrying with it all traces of air, and the melted insulating compound is admitted. Any trace of the hydrocarbon vapor will combine with the insulating material or be harmless, inasmuch as it is itself a good insulator. The apparatus may be assembled in a tank of the hydrocarbon and then removed and placed in the melted insulating compound, the heat driving off the hydrocarbon vapor without the use of an air pump. Suitable hydrocarbons are benzine, kerosene, the alcohols and gasoline, the latter being preferred.

The Electric Power Stations of Granada, Spain.

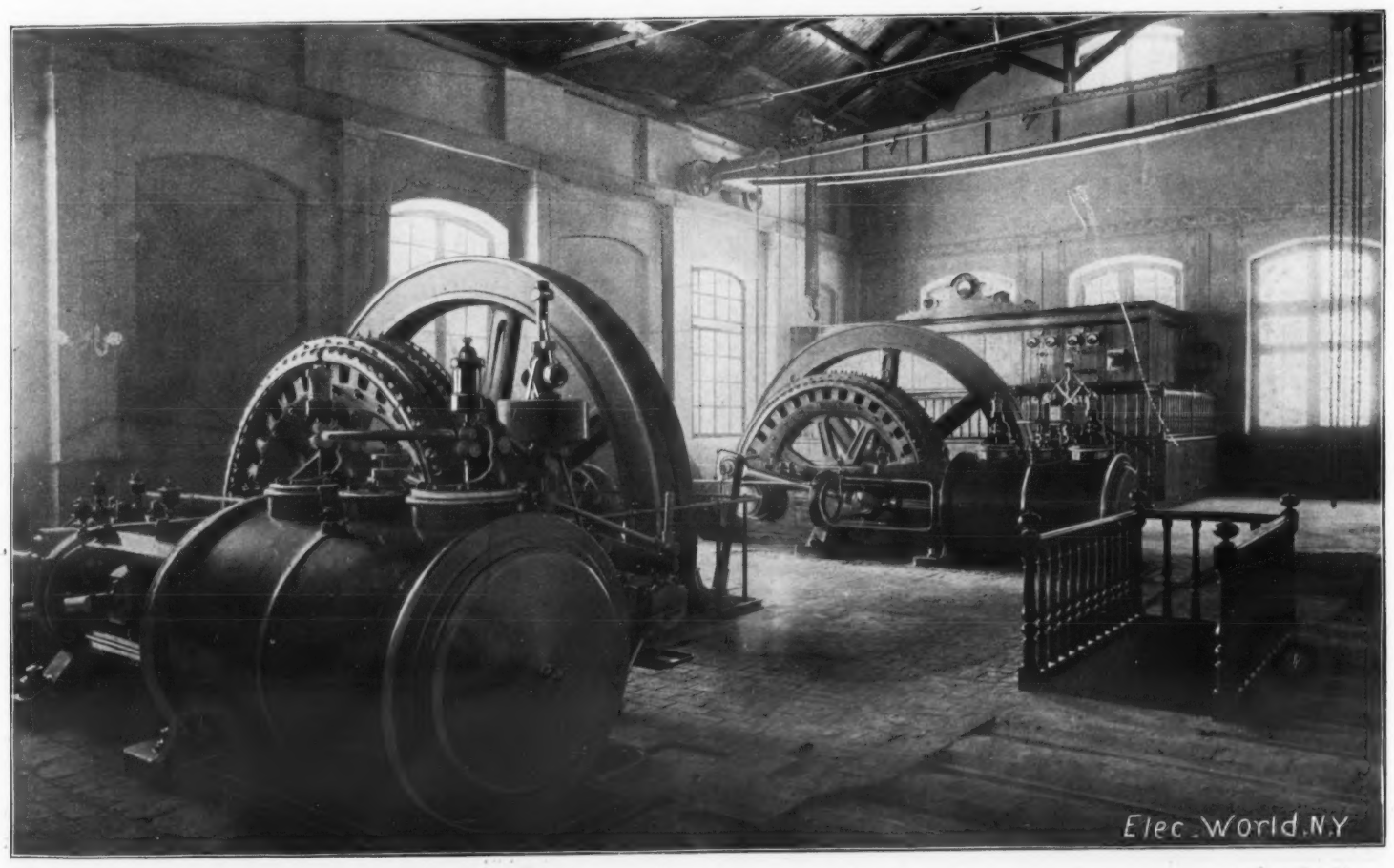
There are two systems competing in the supply of electricity in the city of Granada. One of these uses water power as its prime mover; the other uses steam, but at a cost comparable with that of water power, since the plant is owned and run in connection with the gas works, and the fuel used is coke, a waste by-product of the latter. The two present some engineering features that should prove sufficiently instructive to those responsible for the design of similar plants in this country to warrant their reading the following descriptions, which, with the illustrations accompanying them, have been taken from "Le Génie Civil."

The steam plant is fitted with two single-cylinder low-speed engines, direct-coupled to alternators intended for parallel running, a combination which American engineers do not dare attempt, especially in such small sizes as 200 kilowatts and such low speeds as 100 r. p. m., owing to the difficulty of maintaining such machines in synchronism. The extremely low cost of fuel at the Granada station calls for the simplest engine, compounding being entirely unwarranted and a single-cylinder the most satisfactory from a mechanical point of view. The machines were, therefore, built with fly-wheel alternators, the rotating mass of which is reinforced by extremely heavy fly-wheels. The dynamos are mounted between the fly-wheels and the over-hanging crank of the engine in order to distribute somewhat more uniformly the strains on the journals, by throwing the weight of the fly-wheels on the outboard bearing. Overhanging the latter is a direct-coupled 10-pole exciter. The alternators are of the Alioth construction of the inductor type, delivering single-phase current at 3800 volts with 6400 alternations per minute. The north poles to one side of the fixed field exciting ring are staggered in their angular positions midway between those of the south poles to the other side, so that the armature conductors may be run axially straight across the whole face of the armature. The peculiarities of the latter are that it is pole-wound with coils insulated in caoutchouc and silk on removable laminated armature teeth or poles, with overhanging projections covering the slots, these teeth being separately fastened in by silicon-bronze bolts to the exterior cast-steel ring. The revolving field is made up of two pole rings of unlaminated cast steel.



PLAN AND ELEVATION OF GENERATING UNIT, GRANADA STATION.

The water-power station is situated in a gorge of the Sierra Nevada, about six miles from the city. Although run by a separate company, it was constructed by the same house, and is laid out on very much the same lines as to frequency, voltage, etc., so that the two can be electrically consolidated with ease. Water is carried to the power house by an open canal of brick and rough stone masonry, about three miles in length through a mountainous country, requiring several viaducts, tunnels and arched covers to pro-



THE INTERIOR OF THE STEAM STATION AT GRANADA.

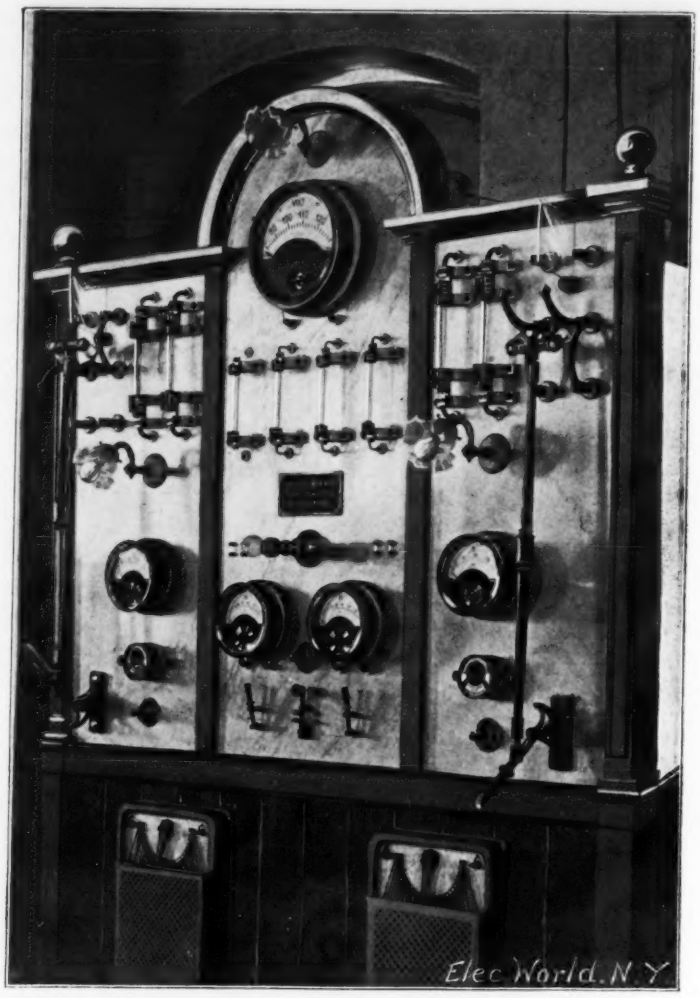
tect it from avalanches and torrents. From the forebay the water is carried to the power house through a steel penstock, with an internal diameter of 40 inches, both the head gates and the receiver below being fitted for the reception of another similar penstock by the side of the first one. The total length of the penstock (which appears in the accompanying illustration of the power house) is 850 feet, the vertical head being 335 feet, of which about 12 feet is lost by friction with the water at full rate of flow, which is a velocity of 3 feet per second.

The power house is constructed for five generating sets of 350 horse power each, of which two are now installed, and the third is under construction. The turbines are horizontal-shaft machines, direct-coupled to generators, and were built by Messrs. Piccard & Pictet, of the well-known outward radial flow type, previously described in these columns.* They run at a speed of 350 r. p. m. The dynamos are revolving-field machines, giving a single-phase current at 4200 volts and with a frequency of 6400 alternations per minute. The construction of the fixed armature is something like that of the large inductor-type machine just described, being pole-wound with removable laminated armature teeth, one per pole, overhanging the slots. The revolving field is of the type generally associated in Europe with the name of an American, Lundell, and in America with the name of a European, Brown; that is, the type in which one coil concentric with the shaft excites the numerous poles lapping over it. The extremities of the latter are laminated. Bipolar exciters are direct-coupled to the ends of the shafts. Each machine is insulated as a whole from ground by porcelain blocks, on which it rests, and an insulating coupling, and to prevent danger to attendants the machines are surrounded by a wooden platform also on porcelain blocks. Particularly high insulation from ground is necessary in this station, as a peculiar atmospheric phenomenon manifests itself, consisting of a static discharge over the lightning arresters every evening at sunset, no matter what the state of the weather may be.

The switchboard is shown in the accompanying illustration, in

The Hydraulic Station and Penstock.

which its peculiarities are quite well shown. The main fuses are in removable glass tubes. The main switches are at the top of the board worked by long arms from below, connected to the switches through porcelain insulators. The upper clips are separated by glass barriers. Owing to the variation of the voltage to give constant potential at the distant end of the line regardless of the line drop, the transformer supplying the station lighting is fitted with taps, by which the ratio of transformation may be changed by manipulating a small switch on the switchboard.



Switchboard of Hydraulic Station.

The lines run to a dozen transformer stations in the city, most of them being in special metallic kiosks at the street intersections. One transformer station is in the Alhambra itself, the apparatus being placed in a special structure designed to conform with the general Moorish style of the architecture. The secondary distributing system is three-wire with 250 volts between outers, supplying 50,000 candle-power in incandescent lamps and some 40 public arc lamps. Single-phase motors are being installed among the shops in the usual way.

*See The Electrical World, November 26, 1898, page 553.

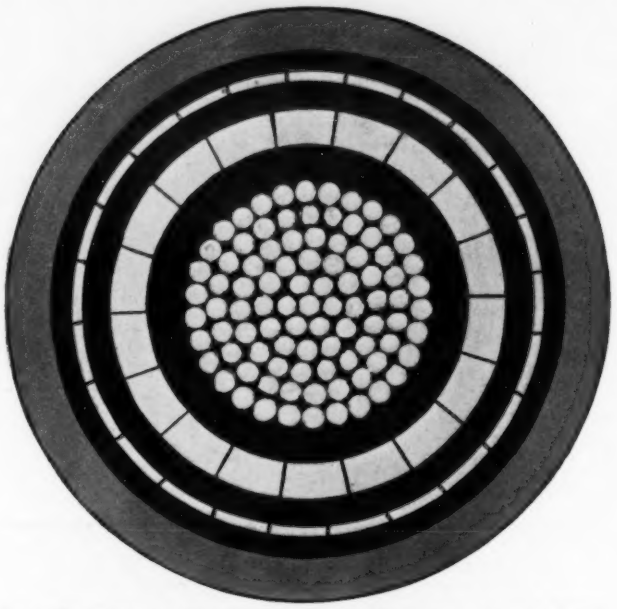
The Dangers of Electricity.

The incident given below, quoted from the London "Electrician," is a suitable companion piece for the blame attached in this country to "defective electric light wires" whenever no other cause can be found for the starting of a conflagration:

An engine driver was found dead on one of the electric locomotives of the City & South London Railway, and at the inquest a physician attributed death to electric shock, as "there was nothing else to account for it." The company's chief engineer gave evidence as to the physical impossibility of electric shock in the position in which the switches, etc., were found; while three medical men, having made an autopsy agreed that death was due to ordinary heart failure, that the condition of the heart would render the deceased liable to fainting attacks, and that there was no burning nor charring of the skin. The coroner, in summing up, pointed to the positive evidence that it was impossible for the deceased to receive an electric shock; yet a presumably intelligent body of twelve good men and true found that "death was due to syncope following an electric shock"!

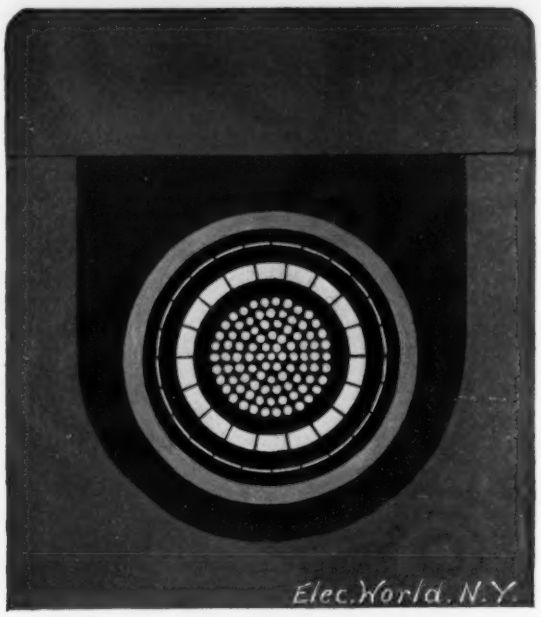
The Laying of Electric Light Cables in Glasgow.

Underground cables in England are very rarely drawn into conduits, being, as a rule, laid solidly under the streets, the advantages of easy withdrawal and extension without excavation apparently being considered there not worth the added cost of a conduit system. Some unusually large cables were recently laid as feeders of the new municipal electric lighting plant in Glasgow, and their laying differed somewhat from the methods ordinarily employed, owing to their size and weight. The following description, with illustrations, is taken from the London "Electrician":



CROSS SECTION OF FEEDER CABLE IN GLASGOW, ACTUAL SIZE.

The largest feeders have three cores, all concentric, two of these cores having each a sectional area of copper of 1 square inch. Two types of cable were supplied, one of which, that of the British Insulated Wire Company, is shown full size in the accompanying illustration. The central conductor is made up of round wires stranded, the two others being built up of flat tapes or strips, as the illustration shows. The cable is worked on the 500-volt, 3-wire system, both positive and negative having a cross section of 1 square inch, and the neutral, which is the outer conductor in the cable, having a cross section of 0.3 square inch. The insulation is of paper and the sheathing of lead one-fourth of an inch in thickness, the exterior diameter of the cable being 3⅛ inches.



SECTION OF DUCT WITH CABLE IN PLACE.

The cable is laid, as the other illustrations show, in troughs and surrounded by pitch or bitumen. The troughs are made of earthenware, or, in some cases, of cast iron, and are covered with plates of the same materials. The laying of the cable differs, of course, greatly from similar work in this country. Two of the accompanying illustrations show different stages of the work. The cable is delivered on reels holding about 120 yards, and is pulled by a winch and steel hawser into the trench over grooved wooden rollers which are mounted about 6 feet apart on wooden standards over the trough, which is first laid down. Wooden saddles are then placed in the troughs to keep the cable from sinking out of centre, the pitch is poured in, the rollers are removed, and the cable is allowed to fall to position.

DRAWING THE CABLE OVER ROLLERS IN OPEN TRENCH.

FOUR DUCTS COMPLETED, FIFTH CABLE BEING DRAWN IN.

The Manufacture of Copper Wire in Japan.

Of the large amount of copper produced in the Japanese mines the greater part has heretofore been exported to and worked up in other lands, some of it being returned to Japan as finished article. The Japanese naturally have endeavored to establish the complete industry at home, and one large plant, the Furukawa Smelting Works, has adopted electrolytic refining. Its output for one year since has been 1,450,000 kin (1,930,000 pounds), and the works are now to be enlarged to four times the size of the old. The Japanese papers announce that on the completion of these new works the output will not only satisfy all the domestic demand, but will allow of the exportation of the finished product. This means a large production, as the governmental department of communication alone has used in one year 1,109,000 kin (1,480,000 pounds) for its wires. The energetic Japanese are now investigating the problems involved in the insulation of wire and the lead sheathing of underground cables, as well as the production of silicon bronze, which has already been attempted.

The Relation Between Mean Spherical and Mean Horizontal Candle Power of Incandescent Lamps.

BY PROF. R. A. FESSENDEN.

This question is one which central station men and consumers cannot neglect. It is, of course, true that quite large variations in candle power pass unnoticed by customers, and that if a man be taken on one evening into a room lighted with 16-cp lamps, and on the following evening into the same room lighted with an equal number of 10-cp lamps, he will probably not notice the change, and it might hence be urged that it is hardly necessary to take small variations into account. It is also true that what the average consumer wants, until he is educated by experience to know better, is glare, and not light; so that in new installations a premium is placed on bad distribution of light sources and bad distribution of light from the sources. And it is also true that the question of whether light or dark papering is used in a room is of much more importance than whether the lamps give 10 or 16 candle power. Yet, on the whole, it will be found, on the average, that there will be fewer complaints when the candle power is highest, and it, therefore, pays to keep it so.

This being assumed, it is evident that the distribution of candle power in the source is one of some importance—a fact which has been prominently brought before the electrical world during the past few years by a number of eminent electricians.

To give a numerical case, if, as is generally the case in practice, we require the light to be thrown in one zone, generally horizontally, then, since, as it will be seen from the tests given below, the ratio,

$$\frac{\text{mean horizontal candle power.}}{\text{mean spherical candle power.}}$$

which we will call the distribution factor, may vary as much as 14 per cent., it is evident that we are, in using the lamp having the higher factor, either throwing away 14 per cent. of our energy, or else burning the lamp so as to shorten its life.

On the other hand, if the lamps are mounted vertically, with the socket lower than the bulb, we should most decidedly use the lamp with the larger factor, unless it be desired to get the most effect possible from the ceiling illumination.

In the winter and spring of 1897 the writer decided to see if the distribution factor could be predicted from the length, position and shape of the filament. A number of tests were made by two of the writer's students, Messrs. Keir and Kiser, and, though no reliable formula was found, it is thought that the sum of the results and a description of the methods used may be of interest.

The lamps tested were as follows :

	Firm.	Voltage.	C. P.	Type of Filament.	Length of Filament.	Factor. Per cent.
1.....	S. M.	48	16	Horseshoe	5⅜	..
7.....	S. M.	48	16	Horseshoe	5⅝	76
2.....	S. M.	98	16	Looped	7⅛″	72
8.....	S. M.	98	16	Looped	7¼″	76
3.....	E.	50	16	Horseshoe	6¼″	80
9.....	E.	50	16	Horseshoe	5⅛	78
4.....	E.	100	16	Looped	9⅞	79
10.....	E.	100	16	Looped	9⅞	82
5.....	P.	110	16	Horseshoe	6⅝	80
6.....	S. M.	110	50	Looped	10⅝	84

Figs. 1 to 6, page 231, show the lamps drawn to scale through two sections. The actual position of filaments is shown as closely as possible, the solid line representing one filament, the dotted the other. The test on lamp No. 1 was not completed, through accident.

In general, two things will be noted: 1st, that the longer the filament in a given type of lamp the greater the distribution factor, In other words, a comparatively low-resistance carbon should be used where uniform distribution is wished; 2d, that, contrary to what was expected, there is practically little difference between horseshoe and looped filaments, as met with on the market, so far as distribution is concerned, the average factor being about 0.76 for looped filaments 8½ inches long, about 0.78 for horseshoe filaments 6 inches long.

The readings were examined with a view to seeing whether the mean of measurements taken with the lamp at an angle of 45 degrees with the photometer bar gave a close approximation to the mean spherical candle power. It did not appear that this was even approximately the case, the results being quite irregular, and the subject will be taken up again, with fresh experiments.

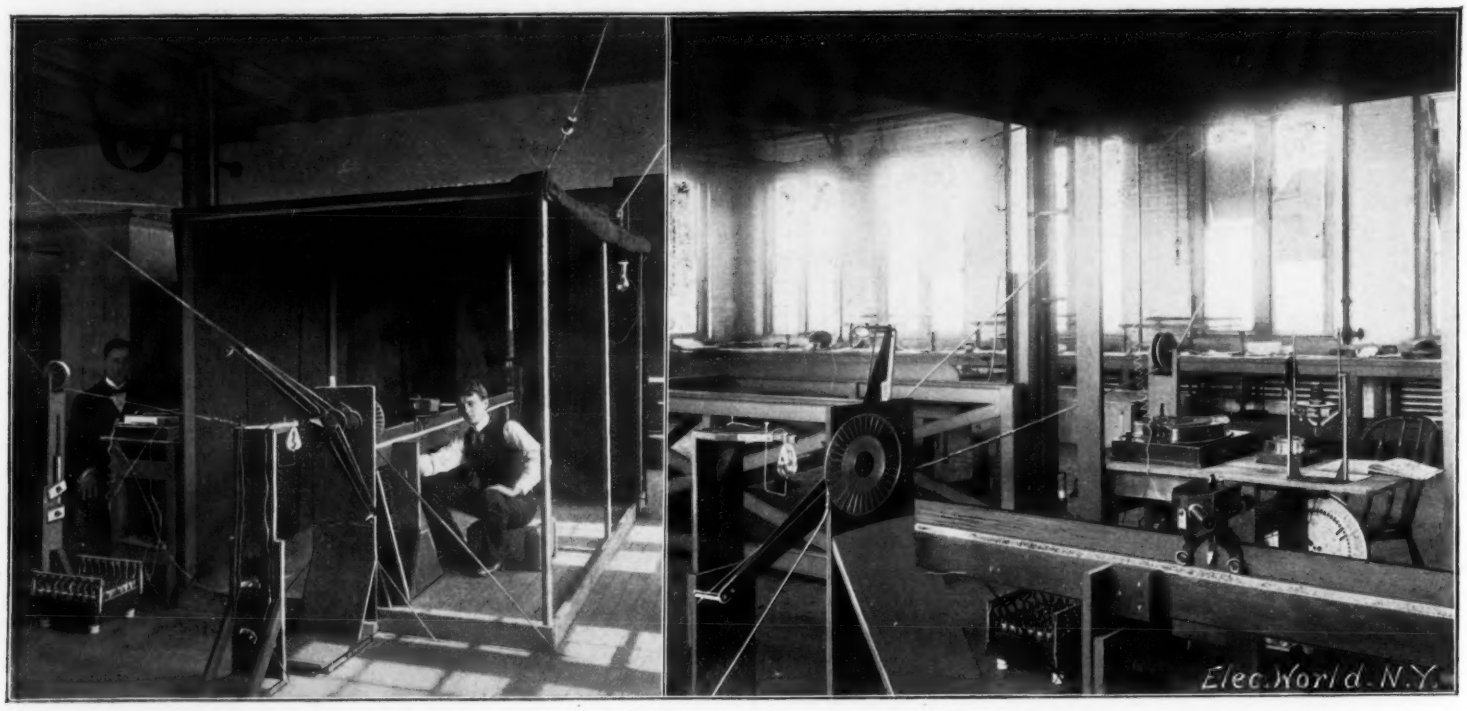


Fig. 7.—Two Views of the Photometer for Determining the Relation Between Mean Spherical and Mean Horizontal Candle Power of Incandescent Lamps.

The apparatus used was that of Houston & Kennelly, described in The Electrical World of May 9, 1896. The illustration above shows the arrangement of the apparatus, which proved entirely satisfactory in practice. This instrument will, it is believed, prove invaluable where accurate and quick measurements of spherical candle power are desired, and would probably be of considerable use to central station men.

My thanks are due to the companies who furnished the lamps, to Messrs. Keir and Kiser for the measurements made, and to Mr. Brashear for his kindness in permitting the use of his shop to make the tests.

An International Physics Congress in 1900.

The council of the Société Française de Physique has decided to convene an international physics congress at the 1900 exhibition. The date has already been fixed, viz., July 16 to 21.

On the Use of the Methven Standard with Blackened Chimney.

BY PROF. R. A. FESSENDEN.

The absolute candle power of the lamps tested, as mentioned in the preceding note, on the relation between mean horizontal and mean spherical candle power, was not known. The gas used in the flame was such as to make the candle power of the light issuing through the standard slot obviously more than two candle power, and the standard was consequently sent to the laboratory of a gas company, which was known to have especial facilities for accurate photometric work.

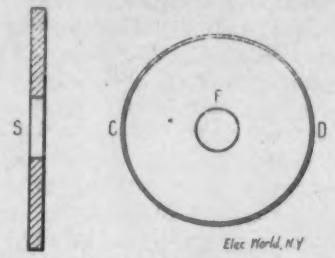
The result of this standardizing gave a quite improbable figure, and the writer finally traced the error to the fact that the standardizer had blackened the back of the chimney of his Methven.

This suggestion, of blackening the rear of the chimney of standard flames, was first made at the Electrical Congress of 1893 by a well-known authority on photometric work, through, no doubt, one of those slips which even Lord Kelvin can number by the dozen. As it was so obviously incorrect the writer, in common, no doubt, with others who must have observed the mistake, did not call attention to the incorrectness of the reasoning. Unfortunately, however, this practice has, I find, been adopted by several experimenters, and as it invalidates all measurements so made a word of warning is advisable.

The argument on which the method is based is as follows: Let *S* in the accompanying figure be a standard slot, *F* a standard flame, and *C D* a glass chimney. Then it is stated that a certain amount of light is reflected from the back part of the chimney *D* and thrown forward through the slot *S*, thus, so the argument goes, making more light pass through the slot than should go. It is pointed out, in proof of this, that if the side *D* be blackened, the light passing through *S* is reduced between 10 and 20 per cent. (if I remember the figures correctly).

But the quite obvious fact, that if *D* by reflection throws say 15 per cent. additional light through *S*, then *C* by reflection throws just 15 per cent. away from *S*, thus leaving the light issuing through *S* just what it was at first, is overlooked. Thus the presence of a glass chimney, if symmetrical, around a standard flame, does not increase the value of the light passing through the slot. As a matter of fact, it slightly reduces it, for two reasons: First, on account of the absorption of the glass; second, because some of the reflected light is thrown out of the ends of the chimney.

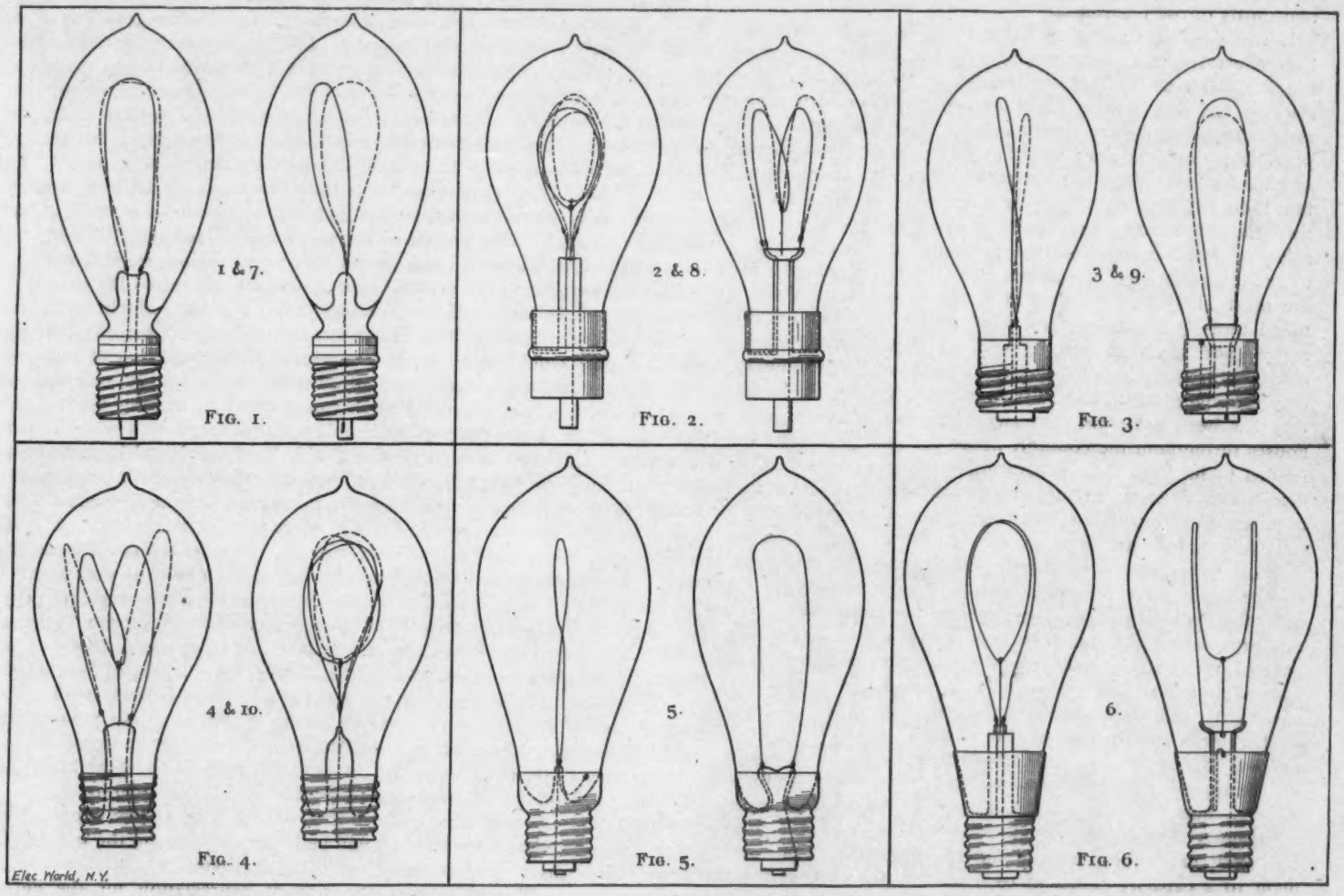
The question is easily brought to a reductio ad absurdum. For consider a symmetrical flame and chimney, both so long in comparison with their diameters that the amount of light issuing from the ends is small compared with that issuing from the sides. Let the amount of light given off by the flame, when without chimney, be 100 candle power. Then, on putting on the chimney, the light falling on a slot placed near the flame will, if the theory on which the blackening is based be true, be increased say 20 per cent. But as the system is symmetrical about an axis, the candle power for every position, round the flame, of the slot, will also be increased 20 per cent.



PLAN OF STANDARD SLOT, CHIMNEY AND FLAME.

Therefore, placing a chimney round the flame has increased its candle power from 100 to 120, immediately evoking the suggestion: "Try two chimneys."

The writer would not call attention to this error but for the fact that he has positive information that blackened chimneys are being used in more than one laboratory, and it would thus appear that good work may be wasted through such false standards.



THE RELATION BETWEEN MEAN SPHERICAL AND MEAN HORIZONTAL CANDLE POWER OF INCANDESCENT LAMPS.

Storage Batteries and Railway Power Stations.*

BY ROBERT MC A. LLOYD.

A difficulty confronting us is that very few operators of railway power stations have any data showing what they are doing. Electric light managers seem to take more interest in the output of their stations, and in many cases maintain a system of records of work done, but the manager of a trolley road is usually contented with superficial observations of the switchboard and the comforting fact that the cars are running.

You are, of course, prepared for the statement that the average load on a railway power station for a given period is much less than the maximum load occurring during that period, and much more than the minimum; but it is not generally understood that the maximum load for the same period is apt to be far below the capacity of the generating plant in operation. The first explanation of this would be that such a surplus capacity is necessary for reserve to meet emergencies, but I do not find it to be a useful reserve, and shall refer particularly to a typical plant running thirty-five cars in a Pennsylvania town of 50,000 inhabitants, taking this station because from the standpoint of the manager, engineers and attendants it is dangerously overloaded, and has no reserve. In fact it was necessary to add to the capacity at once to make it safely operative.

I obtained the data for this plant on the day of heaviest travel in the whole year. The highest point reached was within the capacity of the main station, and yet it was necessary to start up an auxiliary station. Among some of the interesting features is the fact that the nominal capacity of the generating apparatus was about 400 kilowatts in excess of its maximum output occurring at about 8 o'clock in the evening, and that the average output at this time was about two-thirds of the maximum.

It will doubtless occur to some that this station apparatus has been overrated or that the engineer was incapable or overcautious; but the fact remains that similar data are obtained in very many stations, and that in many cases the apparatus has been subjected to satisfactory tests before acceptance by the purchasers. It may be possible to build engines which regulate at all conditions of load, and at the same time use steam satisfactorily, at maximum load, but I do not find such engines commonly in use. Further than this, there are many very good engines in use which cannot be safely operated at anything like maximum load if that load is liable to sudden variations. Experience convinces me that the men who are most likely to be consulted about such a station will recommend more generating plant, and the truth is that there are so many good salesmen pushing engines and dynamos, that station managers frequently fail to get full duty from the machinery which they are operating already. It is not merely that the storage battery has been neglected, but any of us can see in railway power houses throughout the country, where the managers have been persuaded to increase their generating plant when attention to a few details such as steam piping would have brought their output up to requirements. Assuming, however, a station equipped with the best obtainable apparatus, and operated under the most advanced laws of station practice, in the absence of a storage battery there would still be much more apparatus running than would appear necessary from the load diagrams. The generator salesman says, in reply to this proposition, that his apparatus is cheap, and that it is good to have plenty of it, but one generally finds that where there is plenty of apparatus available the engineer is tempted to keep too much of it running, and therefore running at low efficiency.

There are three distinct ways of using a storage battery with such a power plant. We shall call a battery of sufficient capacity to level off the night and day fluctuations "large"; a battery for leveling the hour to hour fluctuations "medium," and a battery to level the momentary fluctuations "small." It will be seen at a glance that the small battery will reduce the requirements of the generating plant to a capacity sufficient to meet the demands of the average load. The battery must be able to discharge heavily for momentary periods, but its capacity in ampere hours is unimportant. It will cost less than generating capacity for the same work, and a large part of the excess of capacity over requirements will be saved. It will save some depreciation on the generating apparatus, and its own depreciation will not cost more than the depreciation of generating apparatus of similar capacity. It will have sufficient storage capacity to run a few night cars and lights when the engines are shut down. If located at a point nearer the centre of feeder distribution than the location of the generating station a saving in copper will be effected. Inasmuch as the investment will not be increased by including such a battery in this railway outfit all the saving in fuel due to a steadier load and the operation of less generating machinery will be clear gain to the credit of the battery.

A "medium" battery to reduce the load to the average for eighteen hours of the day would cost about twice as much as a "small" battery, but will not add enough to the cost of the installation to bring the investment up to the total in generating apparatus alone necessary if no battery is used. This battery will have all the advantages of the small plant with wider limits of operation. The station circuit breakers may be set much higher, and there will be greater convenience throughout the station in operating at a fixed load. There will be a marked effect on the efficiency of all departments of the station, and all the apparatus will yield a higher output in proportion to investment and cost of operation.

A "large" battery capable of leveling off the twenty-four-hour load will cost approximately twice as much as the "medium" battery, and will have all of its advantages. It will cost as much as the generating machinery displaced by it. It will add largely to the flexibility of the station. This battery could be discharged momentarily at a one-half-hour rate, which will put the circuit breaker limit of the station 50 per cent. above that, with all the present apparatus.

In cases of extreme necessity the entire system might be carried by this battery for several hours. The ability to carry sharp peaks is a distinct addition to the earning power of the system. Such peaks often signify the collection of fares, which would be lost if the system were not flexible, and some managers keep up enough station capacity to carry a few holiday crowds, while for 99 per cent. of the whole year it is earning nothing. Other managers do not attempt to carry special crowds. The large battery will give the manager an opportunity to get all the money that can be made out of such business without feeling that he has made any investment for the purpose. Of course the capacity of the system is limited also by the investment in copper, but in many cases the battery may be located so as to facilitate the distribution of power.

There is no reason why a railway power station of this capacity running night and day at a constant load should not attain a fuel economy as high as that of the well-known Chestnut Hill pumping station at Boston, which would be equivalent in electrical work to 557 watt-hours per pound of coal. On the day tested the output of the station mentioned above was 7800-kw hours, which would require at the above rate seven tons of coal, and, assuming that the battery would only have 75 per cent. efficiency and that 25 per cent. of the entire day's work would go through the battery, one-half ton of coal would be added to this consumption, making 7½ tons of coal per day for this plant running with a large battery. The battery efficiency in such service as this has been found in most cases much higher than 75 per cent., and in some cases over 90 per cent., so my estimate is clearly on the safe side. On the day when these data were obtained fifteen tons of coal were burned, or twice as much as would be necessary with the battery outfit. The battery would, therefore, save, at $2 a ton, $5474 per annum in coal alone.

The number of men in the station is now the same night and day, and there would certainly be no increase in the labor item, whereas it is probable that one man on each shift might be dispensed with if the plant were reduced by the battery, in which case there would be another saving of $1200 per annum. The battery would also save water, oil, waste, etc., and there would be minor advantages, such as more constant potential on the line, less annoyance from circuit breakers, no fear of sudden demands on the generating apparatus and the disagreeable possibilities incident thereto.

It is, of course, well known that whatever the rate of depreciation may be without batteries, it will be lowered by giving the generating apparatus a constant load; my belief is, therefore, that the storage battery will not increase the rate of depreciation for the entire plant. If it can be shown that interest and depreciation for a plant of given load dimensions are practically equal with or without a large battery it is evident that the great saving in fuel alone will determine the superiority of the battery system.

I have so far considered the battery only at the central generating station, so that all the advantages due to locating it at proper points in the distribution system are additional arguments in its favor. In many cases the saving in copper may be greater than

*Abstract of a paper presented before the American Institute of Electrical Engineers, February 15, 1899.

the sum invested in the battery, and the flexibility of the system improved in places where it would not pay to install sufficient copper to meet the irregular demands of travel.

The reserve qualities of the storage battery are unique. It might be supposed that a mere reservoir which is quickly drained would be of little value compared to a lot of extra generating apparatus standing idle, but experience is demonstrating every day in existing plants that the reserve which is needed most is the reserve which is not only ready for emergencies but actually alive to any demand without the direction of a human mind.

Electricity has so many advantages over any other medium for transmission and storage of energy that I assume its use to be firmly established and cannot conceive of any lasting rivalry by the other contestants now in the same fields. Further than this, without saying anything for or against monopolies, I believe that all the energy supplied by means of electric currents to consumers of every nature in the Greater New York should radiate from two or three central stations, and that these should be electrically tied together. The substations would naturally consist of rotaries and storage batteries. It may not be possible to lay out each substation so that the rotaries would run at a constant load for twenty-four hours a day, but it seems to me quite probable that such an arrangement would eventually be reached, and this would, of course, give the generating stations a constant load.

At the present time the load curves of the electric railways are very uncertain, and peaks are likely to occur at almost any time of day, while the addition of the peak due to electric lighting in the early evening would not add in large proportion to the railway peak, but electric lighting is capable of more general application, and it is possible that within a few years the distribution in the Borough of Manhattan may reach from three to five hundred thousand kilowatts at the highest part of the lighting curve, which will probably be as great as the railway load when the elevated railway and the underground rapid transit are included. These peaks will often occur at the same time of day, and so there is no possibility of improving the load factor of either system by splicing the two together. It follows, therefore, that what is true of the relation of a storage battery to the economy of the generating station for power or light separately will be true of the resultant of their combination.

The railway and light people recognize the importance of leveling up some portions of their load curves, but I estimate that the greatest saving is to be obtained by operating for a constant load twenty-four hours per day. However high would be the economy of such large stations I am sure it would be higher with large batteries than without. Certainly the economy of the Boston pumping station as to fuel consumption should be surpassed. It must not be assumed that a high load factor for the system is an advantage. It is all right for the generating plant and for the copper feeders, but the kilowatt hours that bring in the most money may spoil the looks of the load diagrams and kill the load factor. What is required to earn dividends is a profitable load factor outside of the stations, whether high or low, and the highest possible load factor at the dynamo terminals. The large storage battery meets these two requirements perfectly. A load factor of 100 per cent. may be maintained at the dynamo and current may be sold to the consumer regardless of the time of day.

With a million kilowatts in view for the Borough of Manhattan it would be necessary to generate an approximately constant force of 300,000 kilowatts. A million kilowatts in a station plant without the battery factor would cost $100,000,000. The same capacity, including the proportion of battery now deemed advantageous by some of the engineers in touch with these problems, would be divided as to cost into $70,000,000 of generating plant and $30,000,000 of battery plant. Finally, the same capacity, if divided in the proportions which seem to me most productive for the investment, would cost $30,000,000 in generating plant and $70,000,000 in battery. This is quite a large battery plant, and as there would be more than two parts battery to one part generator, I am fearful of the jealousy which such a reversal of engineering practice would create.

Meters for Steam.

The Swiss Society for Chemical Industries has offered a prize of £75 for a treatise on the construction of a meter for ascertaining the quantity of steam passing through a given pipe. Competition is open to all nationalities.

Motor Installation at the Chicago "Daily News" Office.*

BY CHAS. A. DRESSER.

In the great development which has occurred in the application of electric power to various forms of machinery the operation of large newspaper presses by electric motors has become, during the year 1898, one of the most important problems to be solved. Several plants have been installed in this country which accomplished their purpose to some extent, but which nevertheless presented as many or more obstacles to the pressman in getting his press ready than the old mechanical method of operation.

It must be remembered that, taking, for instance, the modern Hoe quadruple press, the first thing to be accomplished in getting the press ready is the putting on of the plates, and in order to do this with a mechanical drive a man is stationed at one side of the press, where he can operate by means of foot pressure a friction clutch; another man is stationed at the point where the plates are to be placed on the cylinders to give the first man a signal; the first operator then applies the power to get the cylinders in the proper place.

Assuming that the plates are successfully placed on the press, the next operation is the feeding of the paper through the press. The roll of paper used on such a press weighs approximately 2000 pounds, and ordinarily this is placed on a spindle at one end of the press, and two operators take hold of the thin sheet and cautiously thread it through the various intricate rollers and folders, etc. necessary to produce a complete newspaper. This operation is a very tedious one, and, as can be readily seen, any unsteady or jerking motion exerted on a thin sheet of paper pulling a roll weighing 2000 pounds would necessarily break the paper and require a repetition of the threading process. The total length of paper in the press is about 60 feet. The two operators guide the paper with their hands up to the various rolls and from the rolls after it has passed through them until the press is completely threaded. To do this an absolutely steady motion is not only necessary to avoid the breaking of the paper but—as the operators become familiar with the speed at which the paper is winding through and are constantly pulling on the sheet with a certain amount of tension—in case of a sudden acceleration of the speed of the motor their hands are likely to be caught in the rolls, and many serious accidents have occurred from this cause.

In the newspaper plants equipped electrically previous to the installation of that of the Chicago "Daily News" a single motor is used, either geared or directly connected to the main shaft of the press. This motor is controlled by an ordinary speed controller operated by hand, which presents many of the difficulties of the old friction-clutch mechanical method, inasmuch as it requires two operators, one to control the movement of the press and the other to put on the plates. It is a well-known fact that when a piece of machinery to be driven by a motor is started from a dead standstill the motor momentarily takes a vastly greater amount of current to start it than to continue its motion. To overcome this the old system of electric hand control necessitates the operator's throwing the rheostat arm around a considerable distance in order to cut out enough resistance to give the motor sufficient current to start, and after the motor has started he must then move the rheostat arm back toward the starting point in order to get the slow motion. In this old method of control it is absolutely impossible to avoid a certain jump or start of the motor, consequently the fixing the position of the cylinders for the putting on of the plates is a matter of much greater time consumption on the part of the operator than with the auxiliary motor described hereafter, while the threading of the paper also takes more care and trouble. Therefore, while this system has been successfully used in small newspaper plants where the consideration of first cost is greater than rapidity and labor-saving devices to gain every possible minute in getting out the edition on time, it has been demonstrated far behind the requirements of a modern large newspaper printing office.

At the office of the "Daily News" each press is equipped with two electric motors, the first being a 5-hp, 6-pole motor, having a maximum speed of 200 r. p. m., and suspended on the press at right angles to the main driving shaft. On the shaft of this motor is an automatic friction clutch and worm which engages with a brass gear wheel situated on the main shaft of the press. The speed of the press at the maximum speed of this 5-hp motor is 10 r. p. m.

*Abstract of paper read before the Chicago Electrical Association.

Each 5-hp motor is operated from a speed regulator which has mounted on its face one compressed-air cylinder, one dash-pot cylinder and a contact lever connected to both cylinders. At four different points on the press are located four-way compressed-air cocks which are in turn connected by piping to the cylinders on the rheostat.

In starting the press the operator moves the compressed-air cock to the left, which admits air into one end of the cylinder and opens the other side, forcing a plunger connected to the contact arm through the length of the cylinder, cutting out the different steps of resistance. The dash pot retards the movement so as to cut out the resistance gradually. By the manipulation of this air cock the operator can move the cylinders on the press any desired distance, even down to a sixteenth of an inch, and the greatest dexterity in the handling of this plant is acquired in a few hours' practice.

Furthermore, if the contact arm on the rheostat is on any desired speed point, by quickly placing the air cock in the neutral position the pressure on both sides is balanced and the contact arm remains stationary.

The main power for each press is derived from a 40-hp slow-speed multipolar motor, geared to the press by a single reduction gear and located under the press in the basement of the press room. This motor is set on two sliding rails placed on brick piers, so that it can be quickly disengaged from the gear and any necessary repairs made, it being essential in the operation of a newspaper to have quick action in case of accident.

Each motor is controlled by a rheostat having fifty-five contact points. On each press are situated nine push-button stations conveniently located, each containing compressed-air valves and electric push buttons. The rheostat arm of the large motor revolves on a shaft fixed to a pinion engaging with a rack, which is in turn attached to a plunger in a hydraulic cylinder. The plunger is driven in one direction or the other by water from two other cylinders, the water being forced by compressed air controlled in turn by magnetic valves connected with the push buttons. Any speed may be maintained by releasing the buttons at the proper point. On the face of each large rheostat is a pivoted main switch with springs, tending to hold it open, and to hold it closed a trigger on the armature of the usual low-voltage release magnet in series with the field circuit. This release magnet is short-circuited by the off button, allowing the switch to open, the switch itself operating a compressed-air valve which forces the rheostat arm around to the starting position, the rheostat arm then in turn operating a valve which admits air to a small cylinder which closes the main switch, leaving the motor ready to be started again on pushing the on button,

The paper from the main roll in the press passes over two tension rolls, which are released if the paper is broken, and in that case close a shunt to the off button, shutting down the press. In the basement below each press is a reel capable of holding four rolls of paper weighing 2000 pounds each. These reels are motor-driven to bring to position a new roll of paper whenever one is used up. The press is slowed down to about one-twentieth its maximum speed, a new roll is pasted on to the end of the old and in less than half a minute the press is again operating at full speed, turning out sixteen-page papers at the rate of 24,000 per hour.

In starting a press the first operation is the placing of the thirty-two plates on the cylinder, the press being moved from position to position by the small motor. The next step is to thread the paper. Two men take the end of the sheet and thread it through the various intricacies of the press, which is meanwhile operated at the full speed of the small motor, namely, 10 r. p. m. When the papers come out properly printed the large motor is started, the automatic friction clutch on the small motor lets go and the press comes up to any speed that the pressman desires. The saving in labor alone amounts to a large sum each year, the output of the press is increased 20 per cent. over that of the old mechanical drive, and in case of a slight accident the ease of handling reduces greatly the delay.

Electromagnets Used for Raising Sunken Steel.

It is proposed to use electromagnets for recovering a large load of steel rails which was sunk in the Ohio River. A crane boat will be equipped with waterproof magnets capable of lifting 4000 pounds each. The work will be done by the Langton Electric Company, Pittsburg, Pa.

Nernst's Electric Light.*

BY JAMES SWINBURNE.

Before describing Nernst's invention it may be profitable to spend a few minutes reviewing the position of electric lighting. The whole industry is at present controlled by the incandescent lamp. We are accustomed to this, and it is taken for granted in such an unconscious way that we do not realize how much everything depends on the maker of the carbon incandescent lamp. In very early days, that is to say, in the early eighties, there were a few Edison lamps at 100 volts, with an efficiency too horrible to mention, but the Swan lamp came along made for 50 volts. I say made for 50 volts advisedly; I mean that the makers tried to make 50-volt lamps, and produced lamps taking from 40 to 60 volts. If the lamps were not bright enough you ran the engine faster, or put a smaller pulley on the dynamo. (The belt then generally slipped, but that is not to the point.)

I must point out that the incandescent lamp exercises its tyranny in two ways. It not only insists on a low pressure, such as, say, 100: and thus demands large leads to feed it, but it is so sensitive to variations of pressure that the system of distribution has to be arrangned to give a practically uniform pressure at the terminal of the lamp. The necessity for uniform pressure probably gives more trouble, and costs more than the mere low pressure; and it would be cheaper to supply at 100 volts with a good margin of permissible variation of pressure than supply at 200, with a very small percentage of variation. Quite lately the incandescent lamp makers have produced things called 200-volt lamps, and some make them for 250 volts. So there is a general tendency on the part of supply companies to jump to a 200-volt supply. The innocent consumer is, therefore, pressed by the company to change over to 200 volts. The company likes the change very much, and the lamp maker also enjoys it, as he makes more lamps and charges more for them.

Considering the enormous importance of the incandescent lamp, its improvement has received extraordinarily little attention. It limits us as regards pressure, it used to hamper us by its cost, it limits us as to variation of pressure, and it limits us very seriously by its inefficiency. Yet, in spite of these, the carbon incandescent lamp has made practically no advance in fifteen years. Of course, mere detail improvement in manufacture has taken place, and this has led to better quality and greater uniformity, hence cheapness; but there has been no radical improvement. The jump to 200 volts from 100, or from 50 to 100, did not depend on any sort of radical improvement in the incandescent lamp; it was merely the result of detail improvements, making it possible to produce long, thin filaments. Other things being equal, it is easy to see that the long, thin filaments must be weaker. If the carbon has the same specific resistance, the relation between pressure and length is $E = L^{\frac{1}{2}}$ and $E = D^{-\frac{1}{2}}$. If the filaments are flashed, the proportions will be still more extreme. The question of high-pressure incandescent lamps is thus: How far can we make the filaments longer and thinner and flimsier without exasperating our consumers? Unfortunately the consumer is rapidly getting saddened as it is. The 100-volt 8-cp lamp does not please him much; and the 200-volt 8-cp lamp has in no way delighted him; if the lamp is made with two 100-volt filaments in series, it combines the disadvantages of both, without the advantages of the small candle power of either. But it adds some further disadvantages peculiar to the higher pressure which I have not so far touched upon, and that is that the higher the pressure the more troubles there are through the silent discharge, or whatever it is called. I need only refer to the well-known experiment, in which a third terminal is sealed into the lamp. A galvanometer then shows a current going across country inside the lamp. This is no doubt intimately connected with the life or rather with the death of the lamp.

So far I have only discussed the incandescent lamp; the arc lamp has also to be considered. I will not say much about the arc lamp just now, but will add a little more when the Nernst lamp is compared with it. The ordinary arc is limited in pressure to about 50 volts, including the series resistances necessary for regulating. The enclosed arc is a new development, which is more satisfactory as regards pressure and as regards consumption of carbon.

The lamp I describe to-night is the invention of Professor Walther Nernst, of the University of Göttingen. Though he is a young

*Paper read before the Society of Arts, London, England, Feb. 8, 1899.

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man, Professor Nernst's name is already known to all modern chemists as a leading authority and original thinker in the field of physical chemistry. It is unusual for a man who has climbed to the top of one tree to jump to the top of another. Nernst's, like most great inventions, is exceedingly simple as soon as it is understood. The efficiency of an incandescent body, as far as radiation goes, depends simply on the temperature. The efficiency of an incandescent lamp, for instance, depends on the temperature of the filament only, providing there is no loss by convection. The carbon will not stand a sufficiently high temperature, especially as, in addition to its low specific resistance, the filament has to be long and slender, and thus weak. Nernst, therefore, chose a material that would stand higher temperatures than carbon, and his material has the incidental advantage that its specific resistance is so high that strong rods can be used for high pressures instead of thin filaments. The most refractory materials so far used in lighting are zirconia, which has been used to replace lime in the limelight, and the oxides or so-called rare earths in the Welsbach mantles. I am aware, of course, that many people suppose that the Welsbach mantle is not very hot, treating it as if it were at a temperature, for instance, below the melting point of platinum. The light emitted is supposed to be due to some special power of selective emission due to the oxides employed. I have had a good deal to do with incandescent gas mantles, and I find no reason to suppose there is any magic effect of this sort going on. The part of the flame where the mantles hang fuses platinum wire easily, and very few materials can stand the temperature without fusing or volatilizing. Lime and many other oxides volatilize slowly from the mantles. I do not mean that the mantles are above the boiling point of lime; I have some idea of its melting point, as I have made a few pounds of melted lime, and run it out on the floor to look at it. The Welsbach mantles, which are now chiefly thoria, are at a temperature near their softening point, and in the making are raised to a temperature at which they begin to soften.

Nernst takes highly refractory oxides as his material. It does not seem promising, because such oxides are notoriously good insulators. But such insulators are electrolytes when hot; Nernst, therefore, heats the rods to make them conduct, and then heats them electrically, preserving a temperature which is within the limits that the material can bear without softening. This means that he can take the most refractory bodies supplied by the whole range of chemical research, and can heat them to a temperature short of their softening point, and can thus get an efficiency unknown to workers on the incandescent lamp. Such efficiency also means whiteness of light, so long as the efficiency is not too high. Thus the crater of the arc being at a temperature of boiling carbon, gives a light that is unpleasantly blue. The material is worked up into little white rods. Each rod is mounted on two platinum wires, a little paste made of refractory oxides being applied to the joints. The little rod, with its two wires, is then mounted in a holder which fits ordinary electric light fittings. As the rods fall in resistance as the temperature increases, after the manner of electrolytes, an increase of current produces a decrease of resistance. This tends to give some instability in running in parallel on supply circuits. This instability is corrected, as in an arc lamp which has analogous properties due to a different cause, by a series resistance. The Nernst rod has therefore a resistance in series. This is made up of exceedingly fine wire, and for ordinary circuits amounts to 10 or 12 per cent. of the whole resistance of the lamp. The consumption, including the resistance, is 1.5 watts per candle for large lamps, and 1.6 for small lights or low pressures. In small or low-pressure lamps the loss of heat at the ends is larger in proportion.

Such a lamp as I have described will not light up of itself, for the rod is an insulator when cold. The simplest way to start it is to warm it up with a match, or, better, with a small spirit lamp. Such a lamp as this is not only very cheap as regards first cost, but very economical in running. The life of rods, running at an efficiency of two-thirds of a candle per watt, including the resistance, is already more than 500 hours in good specimens. If the Nernst lamp advances as much in the first few years of its existence as the carbon lamp did between 1880 and 1882, it will soon be made so well that the rods will last a life-time. When the rod is worn out a new rod with its wire mounts is all that is replaced. The whole lamp is not thrown away at all. The method of lighting I have described, though it may be used in many cases, such as large public rooms, is really a savage mode of ignition, fit only for dealing with uncivilized commodities, such as gas and tobacco. The small lamps and the lamps of medium size are in practice started by a heating resistance. This is arranged close to the rod, and in shunt to it. As soon as the rod is hot enough to conduct, its current works a tiny cut-out in the resistance circuit. In large lamps the heating system is a little more elaborate, as the resistance arrangement is arranged as a sort of hood which covers the rod. As soon as the rod conducts, not only is the resistance circuit broken, but the electro-magnet lifts the little hood clear off the rod. In all these forms, the rod and its mounting are replaceable without interfering with the rest of the lamp.

We now have to consider the part the Nernst lamp is probably going to play in the near future. Compared with the small incandescent lamps, as you deal with a material of much higher specific resistance, it is easy to give both small lights and high pressures. The question of lighting is exceedingly important, though it appears trifling at first sight. People are so accustomed to lamps being turned on from the door without any further trouble, that they will generally object to having to light them with matches or spirit lamps, but there are many cases in which it will be quite satisfactory to have one lamp with an automatic lighter to show you the way into the room, the rest being lighted with matches or a spirit lamp as needed. There will be, however, a considerable opening for the cheap, small power, high efficiency lamp; and the disadvantage as to lighting in such cases as cafés, restaurants, churches, hotels, railway stations and, in short, in most public rooms, is small.

Coming now to the next size, that is to say, lamps of 20 candle-power to 200 candle-power, and even small lamps in which it is worth while to have automatic ignition, the first cost of such lamps will be higher than the first cost of incandescents, but as the rod itself has alone to be replaced, that is a matter of very slight importance. This size of Nernst lamp has, further, every chance of completely ousting the carbon incandescent on the score of cheapness as to renewals, higher efficiency, better colored light and perhaps more especially high pressures. Once the Nernst lamp becomes so general that systems of distribution are laid out to suit it, instead of to suit the carbon lamp, the carbon lamp is practically out of the running. It must be remembered that the Nernst can compete with the carbon filament at any pressure that suits the filament, but the Nernst lamp can easily go right out of the depth of the filament, and have the higher pressures to itself. It must be remembered that at present the cost of cables in a system of distribution is an exceedingly large item.

Turning now to the large lamps, they compete with the arc lamp in efficiency. Of course, the efficiency of the arc lamp is not a very definite quantity. The candle-power is generally determined by multiplying the current by two and adding zeros at discretion. All I can say is that however many zeros the good nature of the maker may supply a Nernst lamp taking the same power gives a better light. When carefully arranged on the photometer the arc may be better in given directions, but a lot of light given in directions that you do not want is not the same as the same light distributed with a uniform spherical emission. The arc lamps shown here will give the audience a good idea of the relative values. The Nernst gives a pleasanter, and, of course, a perfectly steady light. Coming to costs, the Nernst will be very much cheaper in first cost, but enormously cheaper in maintenance. It also goes qu'te away from the arc as to pressures. There is no trouble, for instance, in making large lamps to work in parallel at 500 volts, and by using double rods at 1000 volts. This puts an entirely new development of electric lighting in the hands of the engineer.

There is one point I have said little about yet. The incandescent lamp, which is still with us, gives trouble, not only because of the low pressure it needs, but also because it demands that the pressure shall be kept uniform. It seems quite possible that the Nernst lamp may be made to stand a much greater variation of pressure than the filament. If this proves true it means an enormous difference in the disigning of distribution mains. I do not like to say much about this yet, as the invention is too young, and too little time has been available to make much certain progress in that direction. Results are promising, but it is best not to be sanguine. It is difficult to discuss an invention like this without being carried away by enthusiasm. I feel, however, that I have but feebly shown forth the probable future of what seems to me the greatest invention in electric lighting that we have seen for many years. Still I am sure I have not been too sanguine.

Electrolytic Processes for the Extraction, Separation and Refining of Metals—I.

BY DR. D. TOMMASI.

In the electrolytic treatment of metallic compounds more energy than is required for the operation itself has hitherto always been wasted, for the simple reason that in the electrolytic appliances ordinarily used all attempts to diminish the internal resistance and reactions of the bath and to suppress polarization have failed.

The electrical resistance is due:

First—To the distance the electrodes are kept apart, which is considerable, particularly in the case of the refining of certain metals, which, instead of becoming deposited in a compact state, are deposited in a crystalline state, as in the case of zinc, or in a spongy form, as in the case of lead, and would lead to short circuiting, if the anodes and cathodes were not kept sufficiently far apart.

Second—To the lack of homogeneity of the metallic deposit and its feeble adhesion to the cathode.

Third—To the variation of density of the several layers of liquid, the conductivity of which decreases with the density.

These injurious reactions are the result of the attacking action, more or less energetic, of the electrolyte on the metallic deposits, giving rise to the formation of internal counter currents. Polarization is caused by the layer of hydrogen gas which is generated at the cathode surface and which sets up a current in a direction opposite to the principal one.

In order to work as economically as possible:

(1) The resistance of the bath must be reduced to a minimum, and this can be done either (a) by avoiding all possibility of formation of short circuits, so as to enable the electrodes to be brought quite close together; (b) by taking advantage of the condition of the metal produced; (c) by keeping the bath of uniform strength throughout.

(2) Polarization must be done away with by getting rid of the hydrogen as fast as it accumulates on the cathode.

The Tommasi electrolyzer shown in Figs. 1, 2, 3 and 4 consists of a rectangular tank *d*, in which are placed two anodes *P P*, between which lies the cathode *c*, consisting of a metallic disc mounted on a gun metal spindle and capable of being rotated. The disc is not entirely submerged in the bath, but only a part of it is, so that each part comes alternately into contact with the air and the electrolyte. That part of the disc which emerges from the liquid, when the disc is rotated, passes between two scrapers *o*, whose duty it is not only to scrape off the spongy deposit, but also to depolarize the surface of the disc. The deposit as scraped off is collected in suitably disposed receivers.

The anodes can be either in the form of plates or of coarse powder. When used in a granular state the compounds are simply packed in a perforated receptacle, in the centre of which a metallic plate, to act as conductor, has previously been placed, and to make sure of there being good contact between the granular pieces and the conductors a similar metallic plate is placed on the bottom of the receptacle on which they lie. When plates are used they are produced by casting in appropriate moulds. In the larger form of electrolyzers the anodes are made up of two or more parts, so as to enable them to be withdrawn and replaced, if necessary, without having to lift up the disc cathode. The disc is made all in one piece when the metal to be recovered is deposited in a spongy state. It is, however, made in several interchangeable sections when the metal is deposited in a compact state.

The sections with which the cathode is built up are fixed to the spindle by means of bolts or screws, which can be unfastened when it is desired to replace any of the sections. When the sections are coated with a sufficiently thick layer of metal, they are withdrawn by a hook at the end of a chain, which is wound round a winch placed over the electrolyzer. By a suitable arrangement the sections are taken to a bath of molten metal, similar to that deposited on the sections. They are plunged into the bath, the electrolytic deposit is melted in it and the sections can be taken back to the electrolyzer to be again deposited upon.

The advantages of the Tommasi electrolyzer over others are as follows:

A. In the case of metals which become deposited in a spongy state, as, for example, lead:

First—Polarization is entirely done away with (a) by the rotation of the cathode disc in the electrolyte; (b) by the rubbing action of the scrapers on each side of the disc, such operation helping to get rid of the hydrogen clinging thereto.

Second—The metal deposited on the disc is removed as the deposition proceeds, from which the following advantages are derived: (a) The metal being continually removed from the oxidizing action of the electrolyte is not liable to be attacked, and is consequently unable to form local couples by which a current is set up in the opposite direction to the principal current; (b) a considerable diminution of the electric resistance of the bath, since it is possible to bring the anodes and cathodes as close together as possible without any short circuits; (c) considerable saving in the consumption of electric energy, due to the diminution of the resistance as just stated.

Third—The density of the liquid in all parts of the electrolyzer is the same, due to the rotation of the disc, which continually keeps the liquid agitated and mixed, and consequently prevents it becoming saturated at the bottom and feeble in strength at the top, as is the case in ordinary electrolyzers where the liquid is at rest.

B. In the case of metals, such as copper, which are deposited in a compact state: The density of the layers of liquid which the current traverses, is uniform, owing to the action of the rotating disc, which agitates and mixes the liquid, and consequently prevents its becoming saturated at the bottom and becoming weaker in strength near the surface, as is always the case in electrolyzers where the liquid is at rest.

Although the Tommasi electrolyzer can be advantageously employed in all electrolytical refining of metals, such as copper, lead, zinc, nickel, silver, etc., the recovery of tin from tinned iron scraps, the treatment of matte, the extraction of metals from their ores, more particularly zinc, copper, antimony, gold, etc., we shall only

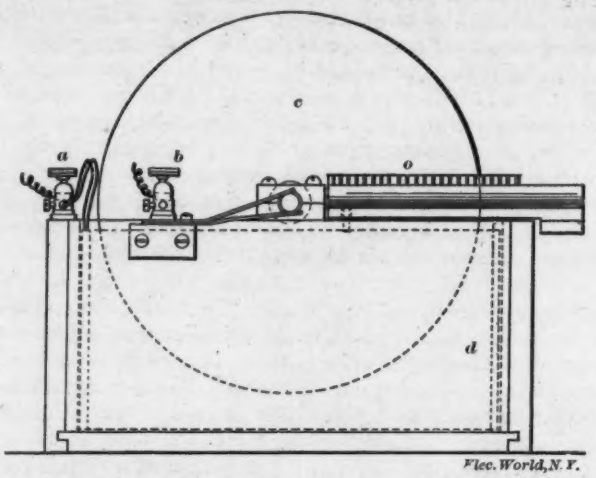


Fig. 1.—Side Elevation of Tommasi Electrolyzer.

deal with the electrolytic desilverizing of argentiferous lead, which has been most completely studied.

The Tommasi Process for Treating Argentiferous Lead.

This process can be applied equally well to argentiferous copper pyrites, to argentiferous blendes and to other argentiferous minerals, but we shall only deal here with the electrolytic desilverization of argentiferous lead.

The principle upon which this process is based consists in electrolyzing a solution of a lead salt, which has not only a very low electrical resistance, but also does not give rise to the formation of peroxide of lead (it is well known that the electrolysis of plumbic solutions nearly always leads to the formation of peroxide of lead, which, in being deposited on the anodes, forms a couple setting up a current in the opposite direction to the principal current, the effect being to increase the resistance of the bath and consequently also the c. m. f. necessary for its decomposition), and to use the argentiferous alloy itself as anode, the cathode being a disc made of metal, which is unattacked by the electrolyte. Under the action of the current the lead in the anodes becomes dissolved and is deposited as spongy crystals on the cathode disc, whereas all the silver in the alloy, being insoluble in the bath, falls to the bottom of the electrolyzer, and is caught in a perforated recipient put there for the purpose. In the event of there being antimony and arsenic present with the silver, they can be separated from it by fusing in a crucible with a mixture of borax and sodium nitrate. The antimony and arsenic are converted into antimoniate and arsenate of sodium respectively, and all the silver remains in the metallic state. The electrolyte used is a solution of the acetates of lead and sodium or potassium, to which is added certain compounds, the nature of which is kept secret.

The method of working is as follows:

The argentiferous lead is melted and cast into suitable moulds. The four one-half anodes—each anode is in two quadrants—are attached to four metal rods placed at the top of the electrolyzer, which are each provided with an endless screw and nuts. These are in connection with the positive pole of the dynamo. The anodes are so held that not only is it possible to keep the electrodes a fixed distance apart, but also to bring them closer together as the anodes become used up.

The cathode disc is placed between the anodes, and is in connection with the negative pole of the dynamo, contact being made by means of a metallic brush rubbing on the spindle of the disc. In working the disc makes one or two revolutions a minute; the disc, which is three metres in diameter, is made of aluminum-bronze, or of nickeled iron. It may be made of copper or even of sheet iron. As soon as the current is turned on the lead commences to deposit on the disc in the shape of spongy crystals.

When the deposit of lead is judged to be of sufficient thickness, and it is thought advisable to remove it, the current is switched off and the scrapers are applied. These scrapers are two brass or aluminum-bronze plates, which, by a simple mechanism, can be brought close up against the disc or withdrawn, as the case may be. By the action of the scrapers the lead is detached and falls into suitable "gutters," by which it is carried to a sieve of wire gauze. The lead is washed with distilled water and submitted to great pressure. The liquid which exudes is collected with the washings, and the whole is evaporated down till it reaches a density

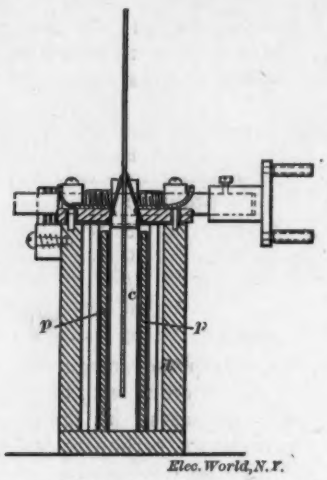
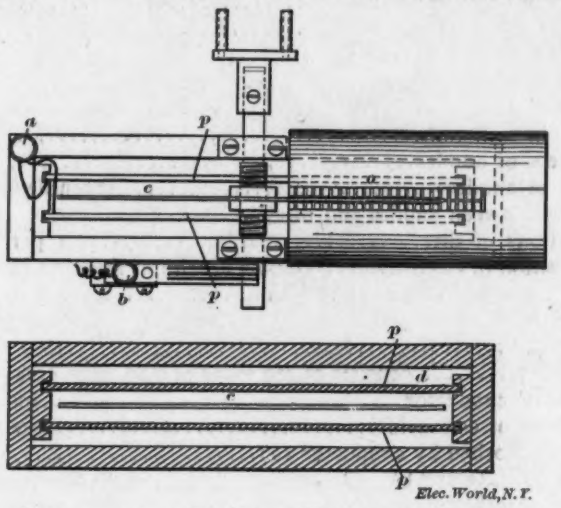


FIG. 2.—VERTICAL CROSS SECTION.



FIGS. 3 AND 4.—PLAN AND HORIZONTAL SECTION.

of 30° Baumé. The solution is allowed to get cold, and is pumped into the electrolyzers. The compressed lead is heated in a crucible with two-thirds per cent. of charcoal powder and cast into ingot moulds.

When the anodes are dissolved they can either be replaced by fresh ones or the silver which has fallen to the bottom of the tank can be collected. In the latter case the disc is raised by suitable means, and the perforated recipient, which had been placed at the bottom of the tank at the beginning of the operation, is taken out, as it contains all the silver which has been deposited from the anodes.

Theoretically, the extraction of silver from an argentiferous lead, or, as it most generally called, the refining of lead, by means of the electric currrent does not demand any consumption of mechanical energy.

The amount of heat evolved by the solution of a molecule of lead as acetate is exactly the same as that absorbed by the setting free of a molecule of lead from that same salt. The mechanical energy is, as a matter of fact, utilized solely to overcome the resistance of the bath, which acts as electrolyte and also the polarization of the electrodes. It should, however, be observed that the passage of a metal from the anode to the cathode must necessarily absorb a certain amount of mechanical energy, but this is so very small that it can easily be neglected. In short, if it were possible to do away with the electrical resistance of the electrolyte and suppress the polarization of the cathode (the anode being soluble does not become polarized), the electrolysis of any salt, using a soluble anode made of the same metal as that of the salt in solution forming the electrolyte, would take place, not without using up no energy at all, but only an excessively small quantity of it, and nothing in proportion to that needed in the refining of some metals, and chiefly in the case of lead, with which we are at present dealing.

It has been impossible up to the present to do away with the polarization of the cathode in the electrolytic refining of this metal and to prevent the formation of peroxide of lead at the anode.

In the refining of lead the resistance of the electrolyte and the polarization are due to the following:

As regards the resistance:

First—To the distance the electrodes are kept apart, which must be at least 10 centimetres, for lead, as is well known, becomes deposited in the form of crystals, the volume of which is considerable (more particularly if a strong current is used), and would eventually lead to short circuits if the anodes and cathodes were not kept sufficiently far apart.

Second—Owing to its feeble adhesion, the lead deposit would very soon become detached from the cathode and fall to the bottom of the bath, if care were not taken to frequently collect it, in fact almost as fast as it is deposited.

Third—To the unequal density of the various layers of liquid, the conductivity of which is less as the density diminishes.

With regard to polarization:

To the layer of hydrogen, which becomes deposited on the cathode, and which gives rise to a current which is in the opposite direction to the principal current.

In the Tommasi electrolyzer, as has already been said, the resistance of the bath is considerably reduced by the possibility of bringing the electrodes closer to each other, even up to two or three centimetres, since the deposited metal, being frequently removed, it cannot lead to the formation of short circuits. As to the polarization, that is completely done away with by the rotation of the disc and the intermittent rubbing of the scrapers when they are brought into contact with the sides of the disc, in order to take off the lead deposit.

To the important advantages of this process already mentioned there is one other, none the less important, to be added, viz., the composition of the electrolyte. At a matter of fact, it is not easy to choose a good bath, particularly for the refining of lead, for that bath must satisfy certain conditions, on which depend to a great extent the success of the operation. These conditions are as follows:

First—The resistance of the bath must be very low.

Second—During the progress of the electrolysis there must be no crystalline or amorphous deposit on the electrodes.

Third—The lead deposited must be in such a state as to adhere sufficiently so as not to fall off, yet not so strongly as not to be removable by means of the scrapers.

Fourth—It should dissolve out the lead only, without attacking the silver contained in the alloy.

These conditions are fulfilled by the use of an electrolyte, the composition of which has been given above, whose electrical resistance is very low, does not crystallize out, nor yields a deposit of peroxide of lead on the anodes, does not dissolve out the silver, and finally yields a deposit of lead, which adheres well to the disc, and yet is easily detached therefrom by means of the scrapers.

As the result of a large number of experiments, for an electrolyzer of the following size and dimensions, the electrical constants,

which we will give further on, can be taken as the basis of calculation:

No. of disc cathodes	1
Diameter of disc	1 metre
Thickness of disc	2 mm.
Height of disc projecting above the electrolyte	40 cms.
Surface of the disc submerged	2910 sq. cms.
Material of which disc is made	copper or sheet iron
Revolutions of disc	1 per minute
Number of anodes	2
Thickness of anodes	1 cm.
Composition of anodes	argentiferous lead
Distance between the anodes	4 cms.
Distance between anode and face of disc	19 mm.
Composition of electrolyte	Double acetate of lead and potassium
Current	75 amperes
Resistance of the bath	.000387 ohm
E. m. f. of the bath	0.29 volt

According to Ohm's law, for a given resistance the current varies directly as the e. m. f.; on the other hand, if the surface of the electrodes is increased, or, in other words, if the resistance of the bath is reduced proportionately to the intensity of the current, the e. m. f. will remain the same.

The following are the details of an installation which would be capable of desilverizing electrolytically by this process from 25,000 to 30,000 tons of argentiferous lead per annum.

Number of baths in parallel	500
Disc and cathodes per bath	1
Diameter of disc cathodes	3 metres
Thickness of disc cathode	2 cms.
Nature of disc	Aluminium bronze
Anodes in each bath	2
Thickness of anodes	5 cms.
Nature of anodes	Argentiferous lead
Distance between anodes and disc	2 cms.
Revolutions of disc	1 per minute
Composition of electrolyte	Double acetate of lead and potassium
E. m. f. per bath	0.75 volt
Total e. m. f. for the 500 baths (a)	375 volts
Current	1800 amperes
Conductor	consists of 400 wires of 6 sq. mm. cross section
Length of conductor	500 metres
Resistance of conductor	0.0035 ohm
E. m. f. absorbed by conductor (b)	6.3 volts
Total e. m. f. (a and b)	= 381.3, say, 382 volts
Energy absorbed	687,600 watts
Power of dynamo	721,980 watts
Motive power	980 horse-power
Cost of a 1000-hp engine	260,000 francs
1 dynamo of 721,980, watts, or 5 each of 144,326 watts	80,000 "
500 electrolyzers, including the electrolyte at 1000 frs.	500,000 "
Total	780,000 francs
Conductor, 20,000 francs	
Interest at 10 per cent. on 780,000 francs	78,000 francs
Interest at 5 per cent. on 20,000 francs	1,000 "
Coal, assuming 800 grammes per horse-power hour at 15 francs a ton	86,400 "
Oil and sundries	10,000 "
2 stokers	5,000 "
2 electricians	5,000 "
30 assistants	30,000 "
Total	215,400 francs

LEAD DEPOSITED IN THE ELECTROLYZERS.

In each bath per hour (1800 x 3.9	7020 grammes
In 500 baths per hour	3510 kilogrs.
In 500 baths in 24 hours	84,240 kilogrs.
In 500 baths per annum of 300 days	25,272 tons

The cost of one ton of lead, therefore, comes to

$$\frac{215,400}{25,272} = 8.60 \text{ francs.}$$

If work was carried on every day throughout the year, it would work out to $\frac{244,923}{30,747} = 8$ francs a ton.

Using hydraulic power (water fall) for driving the machinery, the cost of production of 1 ton of lead would be

(a) for 300 working days a year.....$\frac{145,000}{25,272} = 5.80$ francs.

(b) for 365 working days a year.....$\frac{152,794}{30,747} = 5$ francs

The average cost of the electrolytical desilverizing of argentiferous lead works out at 6.85 francs, say 7 francs, a ton. If we assume 2 francs to include the cost of casting the anodes and of the lead and silver ingots, and incidental expenses at 1 franc, the total cost of the electrolytical treatment of argentiferous lead would certainly not exceed 10 francs a ton. If, however, we consider that lead refined by the ordinary process is worth at least 5 francs more per ton than pig lead, and that, on the other hand, electrolytic lead is much purer than the refined lead of commerce, the conclusion to be come to is that the electrolytic desilverizing of argentiferous lead would not in reality come to, at the most, 5 francs a ton. Notwithstanding these considerations, which have, nevertheless, some value, we shall assume as the basis of our calculations, 10 francs as being the cost of the complete treatment of a ton of argentiferous lead.

By this process, argentiferous lead, poor in silver, can be advantageously treated, i. e., containing 150 to 200 grammes of silver to the ton, and even less, if the cost of fuel is not excessive, or, better still, if water power is available. It is just these poor ores which are the most abundant and the purest, and from which it is not possible to extract the precious metal by chemical processes, for the value of the silver would not cover the cost of the desilverizing of the lead. The following table will show better the advantages which this process for the electrolytic treatment of lead poor in silver offers.

SILVER PRESENT IN ONE TON OF LEAD.

	Cost of Tommasi process (10 frs. a ton).	Cost of chemical process (80 frs. a ton).
110 grammes	profit, 1 fr.	loss, 19 frs.
150 "	" 5 fr.	" 15 frs.
200 "	" 10 fr.	" 10 frs.
250 "	" 15 fr.	" 5 frs.
300 "	" 20 fr.	" 0 fr.
350 "	" 25 fr.	Profit, 5 frs.

This process can not only be advantageously applied to the extraction of silver from argentiferous lead, but it can also be applied to many other important purposes, viz., the preparation of spongy lead for electrical accumulators, carbonate and oxides of lead.

(To be continued.)

Telegraphing Without Line Wires.

To the Editor of The Electrical World:

Sir—Permit me to call the attention of your correspondent in the issue of The Electrical World of February 11 to the introductory statement in my article of January 14, and to the sentence: "About the earliest patent in which the earth is used as a conductor to effect transmission is the English patent to Lindsay."

The article was almost entirely confined to the patented art which offered the best material for an historical review of the subject, with special reference to the needs of the practical inventor, and expressly stated that all the experiments relating to space telegraphy would not be mentioned.

As to Mr. Elisha Gray's experiments in 1877, it may interest your correspondent to read the description of the experiments in 1838 by Prof. Joseph Henry, as given in Vol. 1, page 119, of the "Scientific Writings of Prof. Joseph Henry," published by the Smithsonian Institution, "On the Induction of Secondary Currents at a Distance," which describes telegraphing from one room to the next by induction.

William Bissing.

Washington, D. C., February 17, 1899.

Electricians for the Navy.

Preparations are being made by the United States navy department for the establishment of a school of electricity for enlisted men at the Brooklyn navy yard. It is proposed to train the former apprentices or men acquainted with a machine trade, so that a capable corps of qualified electricians can be organized.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE
AMERICAN AND FOREIGN
By Carl Hering.

Dynamos, Motors and Transformers.

SPARKING LIMIT OF DYNAMOS.

In a brief communication from a dynamo builder at Weiz, published in the "Elek. Zeit.," Jan. 26, it is stated that since Mr. Kapp's recent article his machines were calculated, and it was found that the coefficients for the larger types agree very well with the statements of Kapp, but with the smaller ones, especially those having two poles, there were very important differences, notwithstanding the fact that these machines run sparklessly and give no trouble. Three examples calculated from Kapp's formula are given.—"Elek. Zeit.," Jan. 26.

REFERENCES.

Induction Motors.—The continuation of the author's serial. He discusses polyphase and single-phase induction motors and gives the characteristic curves of a 40-hp motor.—Berg. "Amer. Elec.," Feb.

Lights and Lighting.

MAKING FILAMENTS FOR HIGH VOLTAGE LAMPS.

A brief description of the Maxim process, taken apparently from his recent United States patent, is given in the N. Y. "Elec. Eng.," Feb. 9. The object is to use a species of carbon which closely but not completely resembles the diamond, and which will be less expensive than natural diamonds. It is produced by the combination of very great pressure and high temperature. Carbonic acid gas in a liquid or solid condition is contained in a tightly closed vessel, together with carbon, or preferably a hydrocarbon. The contents are then subjected to the action of an electric arc, and owing to the combined pressure and temperature the carbon will be converted into a species of diamond scales, having "a high quality" of electrical resistance (meaning, presumably, a very high specific resistance). This is pulverized and mixed with some such material as tar, pitch or sugar, and then moulded into filaments, which are carbonized and flashed in the usual way.—N. Y. "Elec. Eng.," Feb. 9.

REFERENCES.

Alternating-Current Arc Lamp.—See abstract of Benischke's article in another column on "New Alternating-Current Instruments."

Power.

UTILIZING THE POWER IN THE NIAGARA GORGE.

Still another project for utilizing some of the power of the Niagara River has been recently investigated for a company by Mr. Birkinbine, a very brief editorial notice of which was given in THE ELEC. WORLD some weeks ago. Some of the data, with two illustrations, are published in the N. Y. "Elec. Eng.," Feb. 9. The plan is to utilize about 5 per cent. of the waters of the Gorge and Whirlpool rapids below the Falls for the production of about 35,000 electrical horse-power, with an outlay of nearly two million of dollars. It is intended to use a 45-foot head of water, leading the water through a canal at the base of the Gorge on the American side, inside of the tracks of the Gorge Railway. The power house is to be just around the bend of the river, below the whirlpool. The average flow of water through the Gorge is from 166,000 to 275,000 cu. ft. per second, at a speed of 21.75 miles per hour between the bridges and the whirlpool. The loose rock is to be removed by hydraulicking—that is, washing it away with strong streams of water. The canal will be 5300 ft. in length and average 100 ft. in breadth. The present price per horse-power at Niagara Falls is $20 per annum for an electrical horse-power, or $12 for a dynamo horse-power; but with the present plant it is expected that this price will be considerably reduced. It is thought that this plan involves less cost per horse-power than when designed to use the vertical drop at the Falls.—N. Y. "Elec. Eng.," Feb. 9.

REFERENCES.

Power on Warships.—A short article showing the great waste in the utilizing of steam in the auxiliary machinery of warships, and pointing out the saving which could be effected by using electrically driven auxiliaries instead. The author found that the consumption of steam per indicated hp hour varied from 96.6 pounds for the electric light engine to 343 pounds for a water-service pump. He favors driving the auxiliary machinery with electric motors.—Roller. "Amer. Elec.," Feb.

Transmission and Distribution Plant at Waukegan.—A brief description of a large private plant in a sugar refinery north of Chicago. The plant is a large one, consuming about 15,000 bushels of corn per day, and as the buildings are scattered, electric power distribution on the two-phase system at 440 volts and 60 cycles is to be used, the machinery being made by the Westinghouse Company.—N. Y. "Elec. Eng.," Feb. 9.

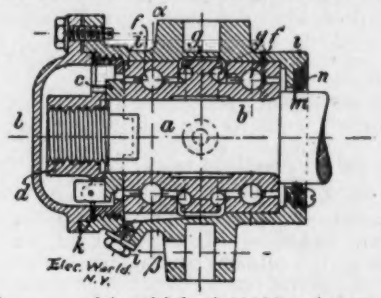
Application of the Electric Motor to Warships.—The beginning of an article discussing this application, the present portion of which, dealing with a comparison of the four methods—steam, hydraulic, electric and compressed-air methods.—Lond. "Elec. Rev.," Feb. 3.

Paderno.—The first part of a long, illustrated description of this plant, which was referred to in the "Digest" Jan. 7, 28 and Feb. 4.—N. Y. "Elec. Eng.," Feb. 9.

Traction.

APPLICATION OF BALL BEARINGS TO STREET RAILWAYS.

Very extended experiments have recently been made in Zurich, Switzerland, with ball bearings on the cars of electric street railways, and they are of special interest, as they were made under normal conditions on a number of existing lines, including numerous grades. These are described in a very long article by Mr. Podoski in the "Elek. Zeit.," Jan. 26 and Feb. 2. The article is of further interest, as the tests included many measurements of the traction coefficient, etc., under various conditions, accompanied by profiles and descriptions of the roads and numerous tables of data; only that referring to the ball bearings can be noticed here. The principal objection to such use of ball bearings is that it was difficult to construct them so that they will stand the very great pressure; for this reason the use of ball bearings has generally been limited to light vehicles or to cases in which there is comparatively little motion. Most forms of ball bearings have failed for street railways, and this was also the case with the earlier forms devised by Schuppiser, of Zurich, owing to the fact that as in other designs he also used the balls only to carry the weight, and it was not until he also used guiding balls for the side pressure that he was successful. The present construction of his bearings is shown in the adjoining



figure, and is the one with which the tests were made. There are two rows of sixteen balls each, 19 mm in diameter, for carrying the weight, and two rows of twenty-six balls each, 12 mm in diameter for taking up the side pressure. They are lubricated by means of a grease which is forced into the bearing. As the wear of the bearings is on only a small part of the circumference, the bearings are so arranged that they may be moved into four different positions, so as to distribute the wear over them. Some of these bearings have been in use on these lines for more than two years, and have given the best results. Much trouble, however, was experienced with the bearings for the balls until these were made of Krupp's crucible steel, but since this material was used they have been very satisfactory, although the time, which is only four months, is too short to draw definite conclusions. He then describes quite fully the very elaborate tests which he made last June. These were made on existing electric railways of that city, on different grades and with different weights of cars, motors and at various speeds; the gauge of all the roads was 1 metre. On one of these lines the results show a saving of power of 20 per cent. due to the ball bearing, notwithstanding steep grades. On a part of the road where the grade was relatively small, about 2 per cent., the saving was much greater, averaging 37.8 per cent. On another line the saving was 36.2 per cent. on certain trips, and an average of 24 per cent. on all the trips. Combining all the figures obtained on the four different lines, the resistance on a level with ball bearings was found to average 15.09, and with the usual bearings 18.42, thus showing a saving in power of about 18 per cent. with the use of ball bearings. The results of the tests have shown the following: That ball bearings involved in every case a saving of power even on steep grades; that the saving on the level when the bearings are in good condition reaches as much as 35 per cent. of the total power; and that the material of which the bearings for the balls are made plays a very important part. The use of ball bearings is therefore to be recommended, provided the material for the bearings gives satisfactory results, and these appear to be obtained with Krupp's crucible steel, although further experience is necessary.—Podoski. "Elek. Zeit.," Jan. 26 and Feb. 2.

NEW GENERAL FORMULA FOR TRAIN RESISTANCE.

What appears to be a very interesting formula, which has the merits of simplicity, is published in the "St. Ry. Jour.," Feb.; it was worked out by Mr. Lundie. The object was to obtain a general formula which should reconcile all existing data and experiments on train resistance; but the present one seems to be limited, or at least based on passenger trains, though it includes all weights and all speeds up to the highest limit so far reached. It is based on a long series of tests of trains in actual service, and is now published for

the first time. Formulas formerly used for track and air resistance have been based chiefly on velocity, and the results are applicable only within narrow limits. His formula combines both the velocity and the train weight, and is applicable to passenger trains weighing from 20 to 400 tons and running at 10 to 75 miles per hour. The formula is said to check up previous experiments with remarkable accuracy. In order to be of value the tests on which such a formula is based must be made on long-distance runs. His method of determining the train resistance was based on an examination of the speed curves of a train when coasting. It is thus not only possible to obtain the gross resistance due to track, friction and air combined, but also to differentiate between the air resistance and the friction. The latter resistance is reasonably constant within somewhat wide limits of speed. Curves are given showing the results calculated for more than 150 runs made on trains of different weights on the South Side Elevated Railroad, of Chicago. The values indicate straight-line curves, which intercept each other with surprising accuracy at a single point located a definite distance vertically above the origin of the co-ordinates, thus indicating a constant. His formula is as follows:

$$R = 4 + S\left(0.2 + \frac{14}{35 + T}\right)$$

in which T is the weight of the transportation unit in tons of 2000 pounds; R is the resistance in pounds per ton, and S the speed in miles per hour. A table is given comparing the values obtained by this formula with those observed by a number of investigators and by the well-known Clark formula, showing a very good agreement, although in all but one case the results are slightly higher than those which were observed. The former results were obtained from heavy railroad trains for which he made no experiments, as his tests were made with comparatively light elevated-railroad trains. It appears, therefore, that his formula is applicable to the whole range of passenger trains on a straight, level, exposed track in a calm atmosphere; it is not applicable to street cars running on dirty rails, for which probably no formula can be given, owing to the large factor of safety to provide for differences in the condition of the track. The question arises whether his formula can be modified so as to be applicable to freight as well as passenger trains. It does not check the most recently obtained data for exceedingly heavy trains, and the article suggests the collection of reliable results for freight trains in order to see whether the formula can be modified so as to apply to them as well.—Lundie. "St. Ry. Jour.," Feb.

ELECTRIC TRACTION FOR HEAVY RAILWAY WORK.

A reprint of a recent paper by Mr. Feldmann is published in the "Elek. Anz.," Jan. 26 and 29. It is general in character and a sort of recapitulation of the subject, containing also numerous data concerning steam and electric roads, from which some comparisons are made. To replace the steam locomotive by electric traction there are three methods possible; one is to store the energy in accumulators carried by the locomotive; it would be possible with the present accumulators to provide a locomotive with a minimum of 200 horse-power and a maximum of 600 horse-power for a trip of 70 km hours and for about two or three hours without recharging, but the weight and cost would at least be equal to those of a normal steam locomotive of equal power, and therefore there would be no advantage. The second method is to use the Heilmann locomotive, but after a brief discussion he concludes that the solution is not to be sought for in this direction. The third method is to use the trolley or third-rail system, and this he discusses at some length, giving data for existing lines. He comes to the same conclusions as those announced by Mr. Sprague in 1896, namely, that the future does not lie in a complete substitution of electric traction on the large existing lines, but rather in a special field with certain limitations but great prospects. Electric traction will soon control that field, and be preferred to all other methods of transporting energy; it will replace the steam locomotive on many branch and suburban lines, will be used on all street, elevated and underground railways, and will probably become a valuable auxiliary system in connection with the main steam lines. But electric traction will not replace the steam locomotive any more than the dynamo or electric motor would replace the steam engine. Steam and electric power each have their own field.—Feldmann. "Elek Anz.," Jan. 26 and 29.

STORAGE BATTERY TRACTION.

Some brief extracts from the last annual report of the storage-battery line in Chicago are given in the "West. Elec.," Feb. 11. The reports are said to be very encouraging. The receipts per car day were $16.82, and the expenses $14.61; the receipts per car mile were 10 cents and the expenses 8.7 cents; 1,227,000 kw hours were generated at the power house during the past year, and the total operating and maintenance cost per kw hour was 0.97 cents. The cost of "operating" (whatever that may include) and maintaining the batteries was $4625, and the number of car miles run was 609,767, thus making the "battery expense" per car mile 0.758 cents, which is a little less than 9 per cent. of the total cost of operating and maintaining the road. The average mileage for each car battery of seventy-two cells is 23,000, after which the positives need to be renewed; one set of negatives will outlast three sets of positives. When new the batteries run 22 miles on one charge, but in a short time this is reduced to 11 miles; they have made as high as 40 miles on one charge. The schedule speed is 12 miles an hour, but they are capable of making 30. During January 1.65 kw hours at the switchboard were used for each car mile, which is said to be about the average for the year.—"West. Elec.," Feb. 11.

HUNGARY.

A short article containing tables showing the condition of inter-urban railways and tramways in Hungary. At the end of 1896 the total length in operation was over 6356 km; a table gives the length, equipment, cost, earning capacity, etc., of each. In 1897 Budapest had the largest electric railway and system in Europe, its three power stations having a total capacity of 8000 horse-power. Some details regarding a number of important proposed roads are given. —Ziffer. "St. Ry. Jour.," Int. Edition, Feb.

REFERENCES.

Combined Conduit and Surface-Contact System.—A brief, illustrated description of a system devised by Stendebach and Linker. It is a combination of the open conduit with contact studs between the tracks, the conduit serving only for admitting the contact closer. —Lond. "Elec. Rev.," Feb. 3.

Tramway Opportunities of the World.—The first of two papers in which the tramway conditions in every country of the world are to be briefly described and the financial relations of each country with the great investment centres are to be indicated.—"St. Ry. Jour.," Feb.

Electric Traction.—A reprint of the paper noticed in the "Digest" last week, together with the beginning of the discussion, which is given much more fully than in the reprint noticed last week.—Parshall. Lond. "Elec. Rev.," Feb. 3.

New Process of Welding Rails.—See the abstract in another column of a lecture by Goldschmidt on "Production of Metals at High Temperatures."—"Elek. Zeit.," Jan. 26.

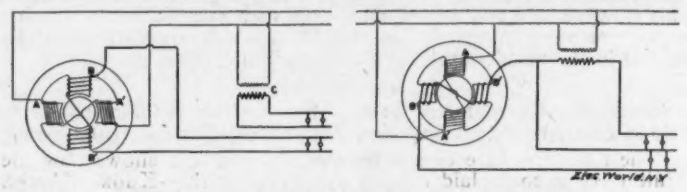
Cork.—A brief, illustrated description, with the switchboard diagram, supplementary to the recent description in a previous issue.—"St. Ry. Jour.," Int. Edition, Feb.

Snowbound Car Systems.—A short article giving practical hints, —Donner. "Amer. Elec.," Feb.

Installations, Systems and Appliances.

FERRARIS-ARNO DISTRIBUTING SYSTEM.

A very brief description of this system is published in the Lond. "Elec.," Feb. 3. As will be remembered, it was suggested by Professor Ferraris a few months before his death, and has now been successfully worked out by his assistant, Professor Arno. Referring



to the first of the accompanying illustrations, suppose the two coils marked A were supplied with an alternating current, and those marked B with another, differing by 90° in phase, then a rotary field will be produced, and if the armature is given a definite polarity it will rotate synchronously with the field. If now the coils marked B be disconnected the motor will operate as a synchronous one, and will generate an e. m. f. at the terminals of the coils marked B, differing 90° in phase from the primary current in the other two coils. After once being started the motor therefore acts as a transformer. With the aid of a stationary transformer, as shown in the adjoining figure, this induced e. m. f. may be made two-phase, although the current in the main circuit is only single-phase. It is also possible to have three wires in the secondary circuit, as shown in the second figure. The latter method is used especially for starting motors with the aid of a third wire from one of the transformers. A number of motors at the recent exhibition in Turin made by Ganz were started in this way.—Lond. "Elec.," Feb. 3.

REFERENCES.

Lighting Country Houses.—A reprint of a paper for architects, giving general information to guide one in designing such plants. Accumulators are considered a necessity.—Drake. Lond. "Elec. Eng.," Feb. 3.

Meter Practice.—A short article on the testing of meters at the consumer's premises, a practice which the author claims is the best one if properly carried out.—L. C. Reed.—"Amer. Elec.," Feb.

Brighton Breakdown.—A reprint of the description, including the diagram, of this curious accident, numerous references to which have already been given in the "Digest."—"Amer. Elec.," Feb.

Glasgow.—A short, illustrated description of the electrical stations in that city. Certain parts of the construction are said to be a good study in emergency work.—Lond. "Elec.," Feb. 3.

Cost of Municipal Enterprise.—Editorial discussions of a recent Society of Arts paper of Mr. Davies.—Lond. "Elec.," and "Elec. Eng.," Feb. 3.

Brixton.—A brief, illustrated description of a plant for lighting a private estate.—Lond. "Elec. Rev.," Feb. 3.

Repairing Electrical Machinery.—Descriptions of some workshop hints.—Fels. "West. Elec.," Feb. 11.

Wires, Wiring and Conduits.

PROPERTIES OF ALUMINUM AND HARD-DRAWN COPPER WIRES.

A table of some interest compiled by Mr. Jones, of the Postal Telegraph Company, giving some of the properties of such wires of

the sizes used in telegraph and telephone work, is published in the "Teleg. Age," Feb. 1. The information concerning the aluminum wire was supplied by the Pittsburg Reduction Company. The temperature coefficients per degree Fahr. are presumed to be as follows: Hard-drawn copper wire, 0.002155; aluminum wire, 99 per cent. pure, 0.002138:

ALUMINUM WIRE					HARD-DRAWN COPPER WIRE.				
American gauge.	Diameter, mils.	Weight, pounds per mile.	Resistance per mile, ohms at 60° F.	Breaking weight, pounds.	American gauge.	Diameter, mils.	Weight, pounds per mile.	Resistance per mile, ohms at 60° F.	Breaking weight, pounds.
5	182	157.	2.66	1,600	7	144	332	2.64	1,000
6	162	125.4	3.37	1,280	8	128	262	3.35	800
7	144	99.3	4.24	1,040	9	114	208	4.22	650
8	128	78.8	5.35	800	10	102	166	5.29	500
9	114	62.5	6.75	640	11	91	132	6.65	400
10	102	50.4	8.52	480	12	81	105	8.30	300
Aluminum mile ohm, 421 pounds.					Hard-drawn copper mile ohm, 878 pounds.				

At the present quoted prices of 29 cents a pound for aluminum and 16 cents for copper, the wires of the former metal, equivalent in resistance, are the lowest in price. (It should not be overlooked that this refers only to bare wires, as the insulation of the larger aluminum wires will probably more than make up the difference.)—Jones. "Teleg. Age," Feb. 1.

REFERENCES.

House-Wiring Regulations.—The Institution papers referred to in the "Digest" last week are reprinted in the following journals: Crompton's, Lond. "Elec.," "Elec. Rev." and "Elec. Eng.," Feb. 3; Wordingham's, Lond. "Elec." and "Elec. Rev.," Feb. 3; Pigg's, Lond. "Elec. Eng.," Feb. 3. The discussion is abstracted in the Lond. "Elec. Rev." and "Elec. Eng.," Feb. 3.

Rubber and Paper Cables.—Brief answers to the question what the specific resistance of rubber and paper compounds are, as used for cable-making; also calculations of the insulation resistance and comparisons with the data for actual cables.—Lond. "Elec. Eng.," Feb. 3.

London and Birmingham Underground Cable.—A reprint of a portion of the article from the Lond. "Elec. Rev.," but including very few of the illustrations, which was noticed in the "Digest" last week.—N. Y. "Elec. Rev.," Feb. 15.

Interior Wiring.—In this continuation of the author's series of articles he takes the case of a particular building and shows how the circuit work is to be laid out from start to finish.—Knox. "Amer. Elec.," Feb.

Electro-Physics and Magnetism.

ROENTGEN RAYS.

In these continuations of the author's notes on "Roentgen Light" he shows a tube with an internal diaphragm, and discusses what he calls the anode rush, showing the deposit it produces on the walls of the tube; one tube is shown which was run "in harmony" with the generator and another which was not, the latter showing visible metallic deposits, thus pointing out the importance of proper tuning. The "seehear" is described and illustrated; it is an apparatus enabling one to both see and hear the action of the heart or lungs, it being a combination of the Roentgen-ray apparatus and a stethoscope. The girdle separating the brightly illuminated parts from those less illuminated is also briefly discussed. In the issue of Feb. 15 he gives an illustration of his tubes, in which the target may be rotated so as to keep it from burning through. He advances the theory that the air contains gases much lighter than hydrogen. He discusses the equivalent air gap, multiple photography, and concave anodes.—Rollins. N. Y. "Elec. Rev.," Feb. 8 and 15.

COHERER.

In a brief communication by R. H. Bell, in the "Amer. Elec.," Feb., he claims having found that an excellent powder for the Marconi coherer is a simple mixture of equal parts by volume of silver and carbon filings, with a small proportion of iron filings. He also found that coherers could be dispensed with altogether by using a narrow strip of tinfoil hanging vertically and resting near its lower end lightly against a sharp edge of a carbon, the pressure being regulated by inclining the apparatus more or less. Connecting this with a telegraph relay and sounder, it is said to work admirably with an oscillator. One of the advantages is that the pressure can be regulated, thus giving clear, distinct signals.—Bell. "Amer. Elec.," Feb.

DIELECTRIC CONDUCTION.

The conductivity of a dielectric can be shown by inserting large thin sheets between metallic plates. In this way Mr. Leick obtained a resistance with a sheet of gutta percha of only 90 ohms. In his experiments, which are described in the "Wied. Ann.," No. 13, and very briefly in the "Lond. "Elec.," Feb. 3, he found that the current in this case did not obey Ohm's law, as the conductivity steadily increased with the current. He found that this was not due to polarization, nor to the heating of the material by the strong currents. Gutta percha and paraffin show no polarization, but sulphur and collodium show it very strongly.—Lieck. Lond. "Elec.," Feb. 3.

VISIBILITY OF ROENTGEN RAYS.

Mr. Dorn, who has studied the effect of Roentgen rays on eyes, has recently made experiments with totally color-blind persons, the results of which are described in the "Wied. Ann.," No. 13, and abstracted briefly in the Lond. "Elec.," Feb. 3. One of them saw the Roentgen rays with an almost painful brilliancy in the form of an elliptical ring. He concludes that only the rods on the retina, and not the cones, are sensitive to Roentgen rays. The experiments are claimed to show that the mechanism of perception for the Roentgen rays is practically identical with that for ordinary light.—Dorn. Lond. "Elec.," Feb. 3.

REFERENCES.

Resistance and Inductance to Oscillatory Discharges.—A mention of a Physical Society paper on the equivalent resistance and inductance of a wire to an oscillatory discharge. It is not abstracted, and is said to be of a mathematical nature. The author modifies the analysis of Lord Rayleigh and extends it to include the decaying periodic currents from a discharging condenser, and to Hertz waves in general.—Barton. Lond. "Elec.," "Elec. Rev." and "Elec. Eng.," Feb. 3.

Discharges in Rarefied Gases.—A preliminary note on the action of magnetized electrodes upon electrical discharge phenomena in rarefied gases, and especially on the charged residual gas.—Phillips. Lond. "Elec.," Feb. 3.

Kite Experiment.—An abstract of an article describing experiments on atmospheric electricity made with kites.—Eddy. "Monthly Weather Review," abstracted in the N. Y. "Elec. Rev.," Feb. 15.

Steel for Permanent Magnets.—A reprint of the editorial remarks concerning Mme. Curie's researches noticed in the "Digest" Feb. 4.—N. Y. "Elec. Rev.," Feb. 15.

Becquerel and Polonium Rays.—An article describing her recent researches with these rays.—Mme. Curie. "Rev. Gen. des Sc.," Jan. 30.

Power Factor.—Explanations of what the power factor is and why it varies with the load on the motor.—Lond. "Elec. Eng.," Feb. 3.

Magnetism.—A brief editorial discussion of the elementary principles of magnetism.—"Amer. Elec.," Feb.

Electro-Chemistry and Batteries.

BLEACHING SOLUTION.

A note in the Lond. "Elec. Eng.," Feb. 3, refers to the electrolytic production of bleaching solutions in Germany, where this process is used, especially for the finer wares, and where the best possible finish is required. With the old chloride of lime process, small particles were liable to remain undissolved, giving rise to blemishes. Electrolytically prepared bleach is quite free from this effect, thus enabling uniformity and freedom from blemishes to be secured. Moreover, it is not possible to produce a bleach which is highly destructive in its intensity, as with the lime process. One firm has introduced an electrode which is much cheaper than those of platinum and no less efficient (but the plate is not described). No metal is used except for the negative electrodes. Numerous electrodes are placed into the tank, so as to divide it into a number of cells, the electrodes acting on both sides, thus forming the equivalent of a number of cells in series, only the two end plates being connected to the generating source. The ordinary continuous-current dynamos used for illuminating purposes at night are used during the day for the production of the bleach. At 65 or 110 volts and in ten hours 3 cu. metres of bleach lye are obtained from 300 to 400 pounds of salt.—Lond. "Elec. Eng.," Feb. 3.

REFERENCES.

Accumulator Construction.—In this continuation of his serial the author discusses the time-capacity curves of discharge, giving a number of these for different cells, both with respect to the weight of the plates and the weight of the complete battery.—FitzGerald. Lond. "Elec. Eng.," Feb. 3.

Method of Making a Storage Battery.—A brief, illustrated description showing how to construct a storage battery of the Faure type, without the aid of any special tools.—Poole. "Amer. Elec.," Feb.

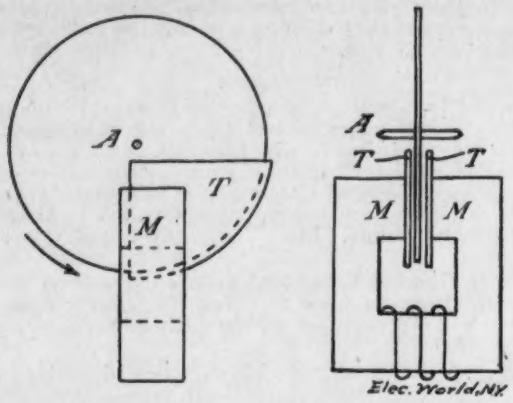
Electrolysis of Alkaline Chlorides.—A brief description of the Solvay process, in which the products are kept separated by gravity; a mercury cathode is also used.—"Zeit. f. Elektrochemie," Jan. 26.

Units, Measurements and Instruments.

NEW ALTERNATING CURRENT INSTRUMENTS.

The principle of electrodynamic screening has been applied recently to the construction of some interesting measuring instruments and an arc lamp, which appear to have advantages, and which are described at considerable length in a recent paper by Dr. Benischke, reprinted in the "Elek. Zeit.," Jan. 26. The underlying principle is shown in the accompanying illustration. On both sides of a metal disc A, which is mounted so that it can rotate, are the poles M of an alternating-current magnet. There are, besides, two plates T which partially cover the pole-faces. The lines of force which tend to pass across the gap pass partly through the fixed screens T and partly through the revolving screen, in which they induce local currents. As these currents are generated by the same field, they have the same direction and will attract each other, thereby producing a torque which will turn the disc in the direction of the arrow. In circuits in which the ohmic resistance may be neglected, Stefan has shown that the distribution of the alternating

currents in their circuits will be such that the total magnetic energy will be a minimum. This will be the case when all of the magnetism disappears; in practice it cannot be made to disappear entirely, and the ohmic resistance is not entirely negligible. He applies this principle to measuring instruments, in which the rotation is opposed by a spring as usual. These have the important advantage that their readings are independent of the curve-form of the current, which is not the case in electromagnetic instruments in which a piece of iron is attracted or repelled in a magnetic field. The torque of these instruments is always proportional to the currents induced in the disc and the screen plates. He shows the independence of the instrument from the curve formed, theoretically. He endeavored also to make them independent of the frequency, and finds that under certain circumstances the torque will be proportional to the frequency, and in other cases inversely to the frequency, thus showing that there must be a point at which it does not depend on the frequency, and he has succeeded in approaching this so that the difference in the readings is only 3 to 4 per cent. for changes in the frequency from 80 to 120. As the frequency in any plant does not vary appreciably, this error is not important. In the construction of the ampere meters the error could not be reduced to this small amount; it is from five to six times that in the voltmeters. The wattmeter is then described; it has three alternating-current magnets, the middle one being in the main circuit and the two outer ones are in the shunt circuit; only the two latter have screens on their polar pieces. He shows that proportionality exists between the deflection of such instruments and the energy. The disc is of aluminum and the screens of copper. Two shunt magnets are necessary, as there would otherwise be a second torque produced by pieces of iron in the neighborhood. The instruments are dampened very effectively. By means of a transformer they may be applied to high-tension circuits, thus enabling the measuring instruments for such circuits to be placed on the switchboard without danger. There is another advantage in this, as the same instrument may then be used to measure the currents in different circuits without opening those circuits, which is of special advantage in three-phase plants, in which it is often required to measure each of the three currents. This is accomplished by means of transformers in which only the secondary circuit leads the instrument and is broken. He then describes the application of the same principle to alternating-current arc lamps. If in the above mentioned device the spring which opposes the revolution of the disc is removed, then the rotation of this disc may be made to operate an arc lamp, as the device will then form a sort of motor, which has the same good properties, namely, the independence of the curve-form and the approximate independence of the frequency. By using both a series and a shunt magnet a differential lamp is formed. The regulation is said to be very sensitive. The same principle may be used for other purposes, as any desired amount of power may be generated, it being quite easy to increase the torque. One of those shown is a signaling voltmeter for alternating currents which will light lamps and ring bells if the voltage varies from a certain fixed value. The large power produced makes it possible to use the device for a registering wattmeter, thus avoiding the use of relays, as the disc carries the pen itself, which greatly simplifies and reduces the size of the apparatus. He claims that this is the first instrument which enables high-tension currents to be registered. Finally he shows how it may also be applied to meters. It enables a three-phase meter to be made in the form of a single instrument instead of two, as usual; it is only necessary to have three sets of wattmeter magnets, as above described, act on the same disc, the total torque being then proportional to the sum of those produced by each of the three phases. These instruments are made by the General Electric Company, of Berlin.—Benischke. "Elek. Zeit.," Jan. 26.



In the discussion Goerges referred to somewhat similar instruments made by the Siemens & Halske Company, and discusses the subject theoretically. Their instruments were almost independent of the temperature. Niethammer claimed that Benischke's instruments were not completely independent of the curve-form because they were not independent of the frequency; this he discusses theoretically, but admits that the effect of different curve-forms in most cases would be insignificant. He claims that the resistance of the instruments would be quite variable with the temperature, as a difference of 30° would represent about 12 per cent. change in resistance; but this would not necessarily involve a proportionate change in the torque. One disadvantage of the instruments is that they cannot be calibrated with a direct current like an electrodynamometer. Benischke, in reply, showed the difference between his instruments and those mentioned by Goerges. He claims that the temperature changes which occur would not be of importance in his instruments when they are used for switchboards, as he admits that for laboratory instruments electrodynamometers are preferable.—Benischke. "Elek. Zeit.," Jan. 26.

ELECTROLYTIC INTERRUPTER.

Of all the devices that have been described recently for making and breaking the current for an induction coil, by far the most interesting and novel, and apparently the most effective, is a device described and illustrated by Dr. Wehnelt in the "Elek. Zeit.," Jan. 26. It differs entirely from all other forms, and from the remarkable results obtained it seems to be far better than others. If a current with a relatively high voltage is sent through an electrolyte between electrodes which differ in size the well-known light and heat phenomenon is produced at the small electrode, a result which has been made use of by Lagrange and Hoho in their well-known method of heating and welding electrically. It was noticed that the light emissions were not continuous but intermittent, and upon examining this intermittent character the author found that it was due, not to a variation of the current but to absolute interruptions, and that an induction coil in circuit operates exactly as though it had been provided with a circuit breaker. The device with which he experimented is illustrated in the adjoining figure, in which *b* is a lead plate and *c* a platinum wire fused in a glass *d*, so that only its end is in contact with the liquid. By connecting this with an induction coil it was found that when the small electrode was made the negative pole it was fused very quickly, but on changing the direction of the current so that the small electrode became the anode—that is, when it was connected to the positive pole of the battery—the results were surprising. Even with a comparatively low voltage a bright stream of sparks was obtained from the secondary, showing that the current was completely interrupted in the primary. The results with large coils were equally successful. Even with only six accumulators—that is, 12 volts and 6 amperes, with a large coil giving 30 to 50 cm sparks—the result was as good as with a Deprez interrupter. By increasing the voltage streams of sparks 28 to 46 cm in length were obtained, with a frequency of about 1000 oscillations. With no other form of interrupter except one was it possible to produce such results. He found that the interruptions were such that the condenser shunting the sparks becomes unnecessary. Moreover, the self-induction is not a disadvantage, but, on the contrary, favors the action, for without self-induction the voltage required will in general be higher. The frequency of interruptions increases with the increase of the voltage. The lowest voltage at which the phenomenon begins depends on the conditions; with a 30-cm spark coil the action began with about 12 volts; the best solution is sulphuric acid at 20 to 25° B.; it is immaterial what metal is used for the cathode, but for the anode the best one is platinum. Tests showed that the interruptions were from 200 to 1500 per second, and in one case they increased to about 1700, as measured with a tuning fork. The current increases with the surface of the "active" electrode—that is, the small one. Experiments with electrodes of different sizes all gave a current strength of 0.41 ampere per sq. mm. of exposed surface. Regulation can therefore be obtained by varying this surface instead of using resistances, which consume energy. With increasing currents the frequency of the breaks diminishes. An incandescent lamp connected in parallel with the coils, but of much higher voltage than that of the battery, will be illuminated brightly; with a 30-cm coil and a battery of 21 volts a 56-volt lamp would burn brightly. The voltages across the terminals of the primary were measured with a quadrant electrometer, and for a battery of 21 volts it was found to be 58.5 volts; with 48 it was 102 and with 105 it is 230; this is a further proof of the completeness of the interruption of the current. The chief advantages of the apparatus are the great frequencies of interruptions, their uniformity, the total absence of any parts subjected to wear, and the possibility of taking current directly from a lighting circuit. The apparatus is especially useful for the production of Roentgen rays, as there is no flickering on the screen and the time of exposure for photographs is greatly reduced by the greater frequency. It becomes possible with this device to get the same results with smaller coils; for instance, a 2-cm coil with a large Roentgen-ray tube intended for a 12 to 15 cm spark will suffice for the hands, and a 15-cm coil with a 30-cm tube is sufficient for the thick parts of the body. It is also useful for generating Tesla currents, for Hertzian waves and for the Marconi system of telegraphy. Also for all the tests for which high-voltage, alternating currents are to be used. If, for instance, the interrupter is connected in a circuit of 110 volts in series with the primary of a transformer having a ratio of one to ten, the voltage of the secondary will not be 1100, but 2200, which if then transformed down again in a similar transformer will give 220 volts in the primary.—Wehnelt. "Elek. Zeit.," Jan. 26.

NEW STRING INTERRUPTER.

A string interrupter is more reliable and adjustable than a hammer, and cheaper and more convenient than the tuning fork. In a new form devised by Arons, described in the Lond. "Elec.," Feb. 3, and more fully in the "Wied. Ann.," No. 13, the electromagnets are dispensed with altogether, thus eliminating the heavy inductances

which make high frequencies so unmanageable. A copper wire carrying the current is attracted by a permanent horseshoe magnet, interrupting the current and causing the wire to vibrate at its natural period. At the centre there is a platinum wire dipping into mercury covered with water. The current enters through this and divides in the wire, leaving at the two ends, thus one pole of the magnet attracts one half and the other the second half. As very thin, short wires can be used, frequencies of 800 to 1000 per second are easily attainable.—Arons. Lond. "Elec.," Feb. 3.

REFERENCES.

Measuring the Resistance of Solutions.—A brief description of an apparatus for applying the Kohlrausch method. The resistance is measured between two electrodes at various distances apart.—Goldschmidt and Reychler. "Bul. Soc. Chem.," 19, p. 674; noticed briefly in the Lond. "Elec. Rev.," Feb. 3.

Telegraphy, Telephony and Signals.

TELEGRAPHY AND TELEPHONY IN 1898.

A brief review of the past year is contained in the "Jour. Télégraphique," Jan. 25. A table of statistics is also given, but as they are not official some of the data are only approximate. The totals are as follows: The length of telegraph and telephone lines in the world, including submarine cables, is 3,266,900 kilometres, of which about one-third is in the United States. Of the total, 615,400 is for telephone lines. These figures include the lines of the railroads, governments and private companies. The total length of wire was 13,334,200, of which nearly one-half is in the United States. Of this total 5,154,300 kilometres was for telephone lines. No date is given in connection with these figures, but presumably it refers to either the beginning or the end of the year 1898. A small table shows the traffic in telegrams; the total number of messages during the year 1898, including the international, was 398,283,000; for the past two years this is an increase of an average of 15,804,000 per year.—"Jour. Télégraphique," Jan. 25.

SUBMARINE TELEGRAPHY.

Some interesting data are given in a recent lecture by Dr. Kennelly, a brief abstract of which is published in the N. Y. "Elec. Eng.," Feb. 9, and "West. Elec.," Feb. 11. The first submarine cable was laid across the Straits of Dover about 1850, but lasted only a few hours. At present there are 150,000 miles of cable laid in the world, and there is a fleet of thirty repair ships. A cable costs, roughly, about $1000 per mile. The difficulty in laying a cable consists in doing it in such a way as to minimize the risk of fracture after it is laid. Wherever the cable rests on rock it will break, and its rupture is only a question of time. The speed of signaling does not cause difficulties where the cable is several hundred miles in length, but above 500 miles delicate apparatus is necessary.—Kennelly. N. Y. "Elec. Eng.," Feb. 9, and "West. Elec.," Feb. 11.

COAST TELEGRAPHS AND SPACE TELEGRAPHY.

An article in which the author indicates the limits to which the problem of coast telegraphs and space telegraphy may be narrowed down. He agrees, as is generally admitted, that space telegraphy will replace metallic-circuit systems only when the latter are impracticable. The article is devoted chiefly to the question of establishing communications along the coast with light ships. The work of a number of investigators is briefly described, and he concludes that the coherer systems as a whole are about to be cast aside, and that preference is to be given to alternate-current inductive systems for coast telegraphy.—Appleyard. "Nature," reprinted in "Sc. Am. Sup.," Feb. 11.

TELEPHONE STATISTICS.

In a short article emanating from the Bell Company it is stated that there are nearly 900,000 miles of wire in use by that company and over one million instruments. The amount of capital invested approaches two hundred million dollars, the real estate alone being valued at about ten millions.—According to another report of that company for the month ending Jan. 20, the net output of instruments in 1899 is 31,829; the number of instruments outstanding is given as 1,156,675.—N. Y. "Elec. Eng.," Feb. 9.

REFERENCES.

Telegraphy.—A long serial by Mr. Jones, entitled "Some Points on Electricity," and of interest chiefly to telegraphists, is being published in the "Teleg. Age." In the issue of Feb. 1 he describes the dynamo local connections and general arrangement in telegraph offices.—Jones. "Teleg. Age," Feb. 1.

Telegraph Stations in Sweden.—The beginning of a description, accompanied by diagrams, of the Swedish telegraph stations.—Lonnqvist. "Jour Télégraphique," Jan. 25.

Duplex Telegraph.—Another description, with diagrams, of the system referred to in the "Digest" Jan. 14.—"Elek. Anz.," Jan. 29.

The Neilson Repeater.—A modification of this repeater is described, with the aid of a diagram.—Hewett. "Teleg. Age," Feb. 1.

Self-Restoring Drops.—A brief abstract from a new edition of a telephone handbook.—Webb. "West. Elec.," Feb. 11.

Telephone Party Lines.—The continuation of his serial.—Webb. "Amer. Elec.," Feb.

Miscellaneous.

PRODUCTION OF METALS AT HIGH TEMPERATURES.

Some time ago the interesting little furnace invented by Goldschmidt was described in the "Digest," in which the heat was produced by the combination of pulverized metallic aluminum with the oxygen from iron-rust or some other cheap oxide. A recent lecture by him describing further applications is abstracted in the "Elek. Zeit.," Jan. 26, and contains some information which may be of interest also to electrical engineers, although the process itself is not electrical. For igniting the charge he found the peroxide of barium to be the best material when mixed with aluminum and some shellac as a binding material. This is formed into a small sphere in which is inserted a piece of magnesium wire; this "cherry," as it is called, is laid on the mixture of aluminum and the oxide and covered with a little of the barium peroxide, and the magnesium wire is then lit, which will start the furnace. Although the temperature in the furnace is over 2000° C., the outside of the crucible remains quite cool, in fact a wooden vessel will answer if lined on the inside with sand. The reducing power of the aluminum is so strong that it is even possible to produce metallic calcium. The action on sulphates is much stronger than on nitrates. He burned a mixture of plaster-of-paris and aluminum, producing strong light effects. There is scarcely a metal which cannot be reduced in this way from its oxide, the only known exception being vanadin. The application of the process in practice is limited by the price of the aluminum, but it is already applicable to quite a wide range. He suggests its practical application for reducing all metals in a very pure form, which is of use to metallurgists. There is a simultaneous production of corundum which is so hard that it is not scratched by a diamond; in parts of the slag small crystals of rubies are formed. It may also be used for brazing when the conditions are such that the usual process becomes difficult, and it then is even a cheaper process than those usually used. It makes it possible to weld together in a very short time the ends of rails for railroads and railways. For this process about 8.8 pounds of aluminum are required per joint, the mixture being placed around the ends, held there with a suitable form, and then ignited. A layer of corundum is formed on the rails, which prevents the union of the metal reduced with the iron of the rails. After being thus heated they may be welded together without difficulty. The cost is reduced by the formation of metallic chromium or manganese, which is of value aside from the value of the corundum produced. One of the advantages of the process is that the heat can be regulated, as it is known with accuracy just how many calories will be set free and are required; the mixture, therefore, can be made accordingly.—Goldschmidt. "Elek. Zeit.," Jan. 26.

ELECTRICITY IN JAPAN.

A few interesting notes showing the progress of the introduction of electricity into that country are given in the Lond. "Elec.," Feb. 3. A map is given showing the location of all the steam and water power plants. Not including quite a large number of isolated plants, there are now about forty-four public lighting stations in Japan, eleven of which are driven by water power. Most of them are in a flourishing condition, paying 10 to 15 per cent., and even 25 per cent. dividends. The American and German manufacturers are doing quite an extensive business there. A number of the railway trains are lighted electrically, mostly by the Stone system. There is quite an extensive telegraph system, including a large number of villages and the number of these lines between the principal towns has greatly increased during the past three years. Telephone exchanges exist at a number of the larger cities, that at Tokio having 4500 subscribers. A long-distance line 376 miles long connects that city with Kobe, and is a complete metallic circuit. The subscribers' lines are mostly lead-covered underground wire. Power transmission is the most important branch of electrical engineering in that country, which is mountainous and therefore provides considerable hydraulic power. In one case 3000 horse-power are transmitted. A dozen or more mines are being operated electrically, and the application of electric power for driving workshops and factories is very popular. Little seems to have been done in electric traction, as there are only six railways, including three under construction. One reason is that the streets are very narrow, and therefore do not permit of rapid transit, and the authorities also object to the unsightliness of the overhead trolley lines. It has been reported that an American is forming a syndicate capitalized at ten million dollars for covering Japan with a network of trolley lines, but the rumor is not credited.—Lond. "Elec.," Feb. 3.

ELECTRIC TIMBER SEASONING.

A brief description of a process which is being tried at the works of Johnston & Phillips, in England, is given in the Lond. "Elec. Eng.," Feb. 3. The wood to be treated is placed in a tank containing a solution of 10 per cent. of borax, 5 per cent. of resin and 5 per cent. of carbonate of soda. The wood lies on the positive pole, a sheet of lead forming the negative pole, lying on the top of the wood and separated from it by a thin layer of felt, which is wet with water. The solution is warmed and the wood is immersed to within about two inches from the top at the start, the solution being gradually lowered toward the completion of the process. A current of 600 amperes at 110 volts across the wood from the bottom to the top causes the solution to be sucked up, permeating the whole mass by electrocapillary attraction. The displaced sap rises to the surface and its resin is again mixed with the solution. The time required is five to eight hours, green wood being much easier to treat than that which is nearly dry. The wood is then placed in a drying chamber or is dried in the open air. The current is 18 amperes per cu. ft. per hour, and at 2 cents per kw (hour) the cost of treating by this process, without including the drying, is less than 0.04 cents per cu. ft. The inventors, Nodon and Bretonneau, claim that this makes the wood absolutely impervious to dampness and prevents decay; moreover, few of the insects which usually attack

wood will do so when thus treated. The process is said to have made great progress in France, where it appears to be used on a large scale.—Lond. "Elec. Eng.," Feb. 3.

TURIN EXHIBITION.

The conclusion of the notes on the electrical exhibits. Besides the description of the Ferraris-Arno distributing system, which is noticed under that heading in another column, brief mentions are made of a number of other exhibits, but most of them are not described. A 70-kw, three-phase dynamo is mentioned, the coils of which are stationary, and there are ten revolving pole-pieces, five on each side of the armature; these are not placed opposite one another, but at an angle of 24°, so that by decreasing this angle to 36° the machine is made two-phase, or when opposite to each other it generates single-phase currents. An illustration of a Ganz motor is also given. At the conclusion of the article it is stated that Pacinotti, whose dynamo of 1864 was exhibited, did not only invent the ring armature, but also a disc and drum armature antedating those of Siemens and Edison. He is still living and is professor of physics at Pisa, but has lately not devoted much attention to electrical subjects.—Lond. "Elec.," Feb. 3.

REFERENCES.

Paris Exposition.—A reprint of an address delivered at the Cincinnati convention on "American Representation at the Paris Exposition."—Peck.—N. Y, "Elec. Eng.," Feb. 9.

Some information as to the present condition of the work is published in Lond. "Engineering," Feb. 3.

Electricity in a Medical Clinic.—A long, illustrated description of the electrical plant and appliances at the Polhemus memorial clinic in Brooklyn, which is claimed to be an exceptionally complete and unique plant.—"Amer. Elec.," Feb.

Action of Electricity on the Growth of Plants.—An abstract of the Brit. Assn. paper noticed in the "Digest" some time ago.—Lemstroem. "Elek. Zeit.," Jan. 26.

Electrical Paradoxes and Problems.—Several further puzzling problems and another solution to one of the previous ones.—"Amer. Elec.," Feb.

Instruction Laboratories at Zurich.—Brief descriptions of the various laboratories at that polytechnic school.—Weiss. "Rev. Gen. des Sc.," Jan. 30.

Book Reviews.

LIGHT-ELEKTRIZITATS UND X-STRAHLEN. By Rudolf Mewes. Second Edition. Fischer's Technologischer Verlag, M. Krayn, Berlin. 131 pages. Price, 250 marks.

This book on X-rays is characteristically German in its thoroughness, giving both the elementary principles and a complete mathematical treatment of the same.

RAILWAY "BLOCK" SIGNALING.—The Principles of Train Signaling and Apparatus for Ensuring Safety. By James Pigg. Biggs & Co., London. 387 pages, illustrated. Price, 7s 6d.

English railway signaling differs widely from that in use in this country. It is to a much greater degree manual and less automatic, but its instruments are perhaps worked out to a higher degree of perfection. This work describes the signals in great detail and gives a good, comprehensive idea of the state of the art in England.

DIE ANKERWICKLUNGEN UND ANKERKONSTRUKTIONEN DER GLEICHSTROM-DYNAMOMASCHINEN. By E. Arnold. Third Edition. Julius Springer, Berlin. 376 pages, 418 illustrations and 12 plates. Price, 15 marks.

The designs of direct-current machinery of this country naturally differ more radically from foreign designs than they do from each other, so that those wishing a broad knowledge of the subject from which they can pick the very best features known the world over for their own work, can find more in foreign books of this kind than in those of American writers. The author is professor and director of the Electro-Technical Institute of the Technical High School in Karlsruhe, and is evidently, from the comprehensive and complete character of his work, well acquainted with the subject treated. Many of the illustrations and notably the tables are made complete working drawings, showing every detail of several commendable styles of direct-current armature construction. History work and descriptions of out-of-date machines have been cut down and the greater part of the contents devoted to the latest types. Even for those not acquainted with the German language the book is of value in the very complete winding diagrams, which are worked out with conventions familiar to American engineers and hence clear without any descriptive matter.

THE ELECTRICAL TRANSMISSION OF ENERGY. Second Edition. By Arthur Vaughan Abbott, chief engineer Chicago Telephone Company. D. Van Nostrand Company, New York. 567 pages, illustrated and with folding plates. Price, $4.50.

The first edition of this work, published three years ago, is well known to electrical engineers, treating as it does elaborately of transmission lines. The author's experience in the telephone field makes him an authority on the subject of overhead pole lines and draw-in conduit systems. The parts of the work treating of these subjects are extremely valuable. In some other lines his work has unfortunately not been brought up with the times in the revised edition. Especially is this true of street railway and long-distance power-transmission work. For example, the chapter treating of open-conduit traction describes the old forms of Love and Pearson conduit, abandoned over two years ago, and makes no reference to anything later. The whole book shows evidences of great care on the part of the author, every description of any complication being carefully illustrated by diagrams.

A New Long-Distance Telephone.

The apparatus illustrated herewith has recently been placed upon the market by the Williams Electric Company, of Cleveland, Ohio. The success of this company in the manufacture of magneto bells and double-pole receivers has been so pronounced that the company has decided to enter the telephone field in its entirety, and is now prepared to furnish as complete a line of telephones as can be manufactured.

Long Distance Telephone.

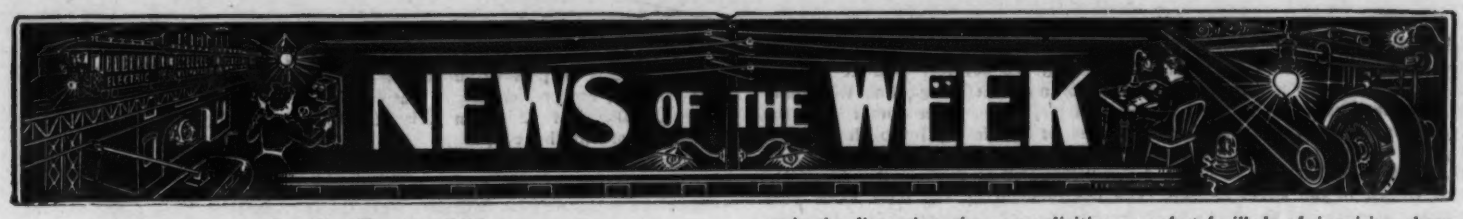
The company's long-distance solid-back transmitter is claimed to be an excellent instrument and guaranteed to give good service. The company claims that the construction of all parts of its instruments is based on scientific principles, and that many novel features, adding largely to the efficiency of the apparatus, have been adopted.

A Trolley Pole of Improved Construction.

The Shelby Steel Tube Company, Cleveland, Ohio, is manufacturing a trolley pole made up of three sections of high-carbon open-hearth cold-drawn seamless steel tube, a longitudinal section view of which is shown in the accompanying illustration. The pole, which is 12 or 13 feet long, according to the requirements, is made up in the following manner: One tube, 12 or 13 feet long, 1 3-16 inches outside diameter; another tube, 8 feet long, 1 5-16 inches outside diameter, and the third tube 4 feet long, 1 7-16 inches outside diameter. The latter is telescoped over the 8-foot length, which, in turn, is telescoped over the 12-foot tube. The gauge of the tubes is 16 to 17 B. W. G., which is equivalent to 1-16-inch wall, or 0.0625 inch. The sections are expanded from the inside in the finishing operation, and the top of the pole, or the small end, is reinforced with 7 inches of 1⅛ inchesx16 gauge tubing.

Improvement in Trolley-Pole Construction.

The pole weighs twenty pounds, and, by test, has been found to stand 120 pounds pressure before bending. The usual requirement of railway companies in this particular is said to be 40 pounds. It is stated that none of these poles has ever bent or broken, and that all of the street railway companies using them speak highly of them.



Financial Intelligence.

HIGH WATER MARK OF BELL TELEPHONE STOCK.—On February 14 the American Bell Telephone stock advanced thirty-one points, and was quoted at 380. This advance was thought to be the result of many investment orders. New England and Erie Telephone stock were higher in sympathy with the Bell stock. New England sold at 142, an advance of 2, and Erie at 100, an advance of 11 points.

DIVIDENDS ON GENERAL ELECTRIC COMMON STOCK.—It is reported in Boston that the General Electric Company will shortly begin the payment of dividends on the common stock, and that the first dividend will be a regular one of 1¼ per cent., and possibly an extra dividend of 1 per cent. It is stated to be the purpose of the company to pay not less than 6 per cent. per annum on the common stock.

THE SALE OF THE EDISON ELECTRIC ILLUMINATING COMPANY, OF NEW YORK.—Owing to the illness of one of the counsel, the completion of the deposit agreement for the deposit of the stock of the Edison Electric Illuminating Company, of New York, with the Central Trust Company, has been delayed, and the time has been extended from February 15 to March 5. This transaction relates to the acquisition of the Edison Company by the New York Gas and Electric Light, Heat & Power Company, which was referred to in THE ELECTRICAL WORLD of January 28, 1898.

THE ELECTRIC STORAGE BATTERY COMPANY stock engaged in some lofty jumping on the Philadelphia Stock Exchange during the past week. On February 16 the preferred made an advance of ten points, reaching 140, and the common stock gained 13¾ points, selling at 140¼, thus presenting the unusual circumstance of a common stock selling above a preferred. Later in the day both stocks made sharp declines. The speculation in Electric Storage has been one of the most sensational movements the Philadelphia market has ever known. The rapid advances may have been due to the report of the acquisition of the Electric Storage Battery Company by the Whitney Syndicate, of New York.

THE MICHIGAN TELEPHONE COMPANY.—Messrs. Poor & Greenough, of Boston, Mass., are offering for subscription $2,500,000 Michigan Telephone Company consolidated mortgage gold 5 per cent. bonds, due January 1, 1929, and dated January 2, 1899, at 99¼ and accrued interest. The proceeds of the sale will be used to cancel $365,000 first mortgage bonds of the company and the remainder for extensions. The bonds are a part of an authorized issue of $5,000,000, and are practically a first mortgage, as only $285,000 of the $750,000 first mortgage bonds originally placed will remain outstanding. The share capital of the company is $2,500,000. The Michigan Company, it will be remembered, recently came into the control of the Erie Telephone & Telegraph Company.

INCREASING THE BELL COMPANY'S STOCK.—It is stated that the directors of the American Bell Telephone Company are considering, unofficially as yet, the formation of a new company to finance the parent company. They are also considering other plans, but, it is stated, all of them include the issuance of new stock. It is thought that favorable action upon a new financial plan for the company will be taken at a meeting to be held in April next. It is admitted that one of the plans contemplates the formation of a new company, to be called the American Telephone Company, and that the present stockholders of the Bell Company will be asked to deposit their stock, and accept therefore shares of the new company or long-distance stock in the proportion of two to three for one.

Special Correspondence.

NEW YORK NOTES.

THE WHITNEY SYNDICATE AND THE ELECTRIC STORAGE BATTERY COMPANY.—It is stated that the Whitney-Widener-Elkins syndicate has secured control of the Electric Storage Battery Company, of Philadelphia. This deal, it is supposed, was the cause of the recent advance in Electric Storage Battery stock of 40 points. The capital stock of the company is $13,500,000.

THE NEW YORK ELECTRICAL SOCIETY elected ten new members at its meeting on the evening of February 14. Their names follow: E. S. Keefer, Western Electric Company, New York; Walter F. Wells, Manhattan Electric Light Company, New York; Robert O. Bacon, the Maintenance Company, New York; Edward Heaton, Port Richmond, Richmond Borough, New York; Harry Robert Benda, New York; Marcus B. Waterman, Brooklyn Borough; J. A. Lynch, New York Telephone Company, New York; Bartow V. Van Voorhis, 2d, Crocker-Wheeler Electric Company, Ampere, N. J.; Henry Drucker, Brooklyn Borough, and Harry N. Ramsey, New York.

"THE HORSELESS CITY."—A very interesting paper on "The Horseless City, or the Age of the Automobile," was read on February 17, before the Quid Nunc Club, of New York City, by Mr. A. L. Riker, president of the Riker Electric Company. The paper was accompanied by a number of lantern slides illustrative of various types of automobiles, including a great many worked out by the speaker himself during fifteen years' devotion to this new and important art. In spite of the stormy weather, there was an excellent attendance. Among those present and participating were Messrs. Chas. A. Terry, Frankland Jannus, J. K. Hoyt, Spencer Peets, T. C. Martin, Dr. Berkens and Prof. J. F. Kemp, of Columbia University. Several ladies also took part in the discussion, the paper eliciting a perfect fusillade of inquiries, showing how deep is the general and popular interest in this latest work in the field of transportation.

DESTRUCTION OF A TROLLEY CAR BY FIRE.—The unusual sight of a burning street car occurred on Lexington Avenue, above One Hundred and Twenty-first Street, on the evening of February 17. Car No. 1710, of the Lenox Avenue (open-conduit) electric line, north-bound, took fire in some way and before the fire engines could reach the scene was totally consumed on the track. The flames spread so rapidly that the motorman did not have time to apply the brakes, although he was able to shut off the current and jump off the burning vehicle. The car ran under its own momentum for about two blocks. There were several passengers aboard, and there was considerable excitement among them in their efforts to escape. They, however, got out without any accident. All that remained of the car was the iron trucks and motors. These were removed from the track in order to clear the blockade, which lasted for about fifteen minutes after the fire was extinguished.

THE MANHATTAN RAILWAY ORDERED OUT OF BATTERY PARK.—Notice was served, on February 17, on Mr. George J. Gould, president of the Manhattan Railway Company, that the elevated railway structure must be removed from Battery Park within six months, in compliance with the agreement made in 1876 between the Park Department and the New York Elevated Railroad, by which the company was permitted to build its structure on a part of the park. President George C. Clausen, of the Park Board, gave out a statement in regard to the matter, to the effect that the railway structure in the park had become a nuisance. He states that he learned, much to his surprise, that there was no legislative authority for the occupation of any part of the Battery by the elevated railroad. The occupation was under a revocable privilege agreement made between the Park Department and the elevated railroad. Under all the circumstances he does not feel that he is justified in permitting the conditions to continue, and therefore issued a notice of intention to revoke the privilege agreement, as above mentioned.

PROPOSED AMENDMENT OF THE RAPID TRANSIT LAW.—An amendment to the New York city rapid transit law of 1891 was introduced in the State Senate on February 15. It provides that the Board of Rapid Transit Commissioners may sell at public auction to the highest bidder the right, privilege and franchise of constructing and operating a rapid transit railway for a period of no longer than twenty-five years, except that provision may be made for one renewal for a further term not to exceed twenty-five years. Provision may be made for the purchase of the road at a fair value by the city upon the expiration of said term of twenty-five years, or from the expiration of said term and of the renewal thereof, as the case may be. If such provision shall not have been made, then upon the expiration of the twenty-five-year term or the term and renewal, as the case may be, the railway property, including the franchise of operation, shall, without any compensation being made therefor, become the property of the city. The bill also provides that after the sale or award of such franchise the powers and jurisdiction of the Board of Rapid Transit Railroad Commissioners shall immediately cease, and all such power and jurisdiction in regard to such railway shall be thereafter exercised by the Board of Public Improvements, which, together with the presidents of the several boroughs of the city, shall be known as the City Board of Rapid Transit.

THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS held its regular monthly meeting on Wednesday evening, February 15, a week earlier in the month on account of the calendar date falling on Washington's birthday. A paper was presented by Mr. Robert McA. Lloyd, entitled "Storage Batteries and Railway Power Stations," an abstract of which is printed on another page in this issue. It was discussed by Messrs. Hill, Mailloux, Birdsall, Coho, Smith, Henshaw, Holmes, Bijur and others. A meeting of the Western members was also held on the same evening at the rooms of the Technical Club, 228 South Clark Street, Chicago, where the same paper was read and discussed. At the meeting of the executive committee, held in the afternoon, the following named gentlemen were elected associate members: Frank Pierce Adams, electrician, Stockton Gas & Electric Company, Stockton, Cal.; Julius Le Roy Adams, chief engineer, Hartford, Manchester & Rockville Tramway Company, Manchester, Conn.; Paul K. Browd, chief engineer, the Russian Electric Company, St. Petersburg, Russia; N. M. Currie, superintendent the Municipal Electric Light Plant, Conneaut, Ohio; John Sturges Codman, consulting engineer, associated with R. S. Hale, Boston, Mass.; Clifford E. Dunn, patent attorney, 229 Broadway, New York; Charles William Hutton, chief electrician Sacramento Electric, Gas & Railway Company, Sacramento, Cal.; Edmund Oscar Schweitzer, electrical inspector, Chicago Edison Company, Chicago, Ill.; Arthur E. Truesdell, assistant to general superintendent, People's Light & Power Company, Newark, N. J.; Marcus B. Waterman, electrical engineer, Brewster Engineering Company, New York city, N. Y.; John Shreeve Wise, Jr., electrician, the Pennsylvania Manufacturing Light & Power Company, Philadelphia, Pa. Mr. George T. Hanchett, of New York city, was transferred to full membership.

"DON'T TRAVEL; TELEPHONE."—Most of the inhabitants of this city and its suburbs couldn't travel during the two days of the recent blizzard, but they could telephone, if there was any occasion to do so, for the telephone service proved to be blizzard-proof. The telephone, it is stated, was then used as it never has been used before, and the wires were, figuratively speaking, kept pretty warm. People who have been wise enough to have their houses connected directly with the telephone system have been in great luck during the snowbound period, as they have been able to carry on their affairs, both business and domestic, with but very slight inconvenience. The natural result of a whole community traveling by telephone and putting itself in its multitu-

dinous places of business by telephone for two entire days naturally threw an immense strain on the service. The telephone system has for some time past been in a condition to cope successfully with the severest possible weather conditions, and the management had little or no anxiety regarding the ability of the plant itself to sustain its reputation for being blizzard proof. But the plant might have lain in magnificent idleness, or got tied up in hopeless delays, had not the full force of trained operators been on hand to cope with the multitude of calls that whirled into a dozen "Centrals" as thick as the snowflakes that eddied in the street outside. The management of the New York Telephone Company had the foresight to arrange that its operators should be snowbound at the business end of their daily journey, and this single measure saved a vast addition to the inconvenience that the blizzard caused the community. As Monday's storm developed orders were issued by the management to quarter the operators at first-class hotels for the night. About one thousand operators and pay-station attendants were so cared for by the company. The next morning they were ready to cope with a day's work such as they have never seen before, as with practically every railway and street car line tied up the business community didn't travel, but telephoned, and telephoned from early morn till frosty eve, every minute of the live-long day. About four ordinary days' traffic of the telephone service were compressed into Tuesday's rapid operations, and nothing gave way.

MAINTENANCE COSTS OF THE BROOKLYN TROLLEY SYSTEM.—One of the New York daily papers last Monday printed an article on the subject of maintenance cost of the overhead trolley system in Brooklyn, which contains many facts of interest to street railway managers. The information is said to have been given by a Brooklyn trolley official, who is now evidently an advocate of the open-conduit system, after an expensive and troublesome experience with the overhead system. "The underground trolley system you have over in New York is illustrating some points of value to us," said he, as he waved a sheet of paper covered with figures of costs for repairing his roads. "I'll bet they have no such items of expense as these. We're just beginning to realize the actual cost of running an overhead trolley system. The wear and tear on the rolling stock, wires and tracks are greater than we ever estimated. The fact is the life of the cars, rails, and overhead work is not much greater than ten years. The wires are not anything like as durable as the tracks. We find that the cost of repairing them increases rapidly every year. I believe all the Brooklyn trolley roads will be forced to adopt the underground system in self-protection. The initial outlay is great, but in the end the profits will be nearly doubled by virtue of the reduced cost of operating the cars. Now, when we first started building electric roads we used a small No. 4 trolley wire. The electricians told us that this small wire would practically last forever. The revolving wheel of the trolley was supposed to reduce the friction to an infinitesimal factor; but it was not many years before the wires began to break. Especially at curves, switches and crossings the breaks were numerous and bad. The wires were wearing out all over; and then we adopted the No. 1 size wire, which is much larger. This was soon superseded by No. 0 trolley wire, and to-day we use the big, heavy No. 00 wire. The electricians told us that we were extravagant in adopting such thick wire; but, considering the wear and tear on even these thick wires, we think it was a wise step. We have to send a heavy current through these wires, and they have to be of the strongest and heaviest nature. When the wires begin to give out the process advances rapidly, and before you know it there is a serious break somewhere. One reason why we prevent breaks to-day is that we replace worn wires just as soon as they show signs of serious friction. When we trusted to the electricians we were dropping live wires in the streets about every day, and lawsuits began to pile up against us thick and fast. The courts held that we were responsible for injuries caused by broken live wires, and this woke us up to a more conservative policy of action. Another serious question with us is caused by the erratic actions of that little overhead trolley. You've watched it spin around on the wires. Well, it goes all right for a distance, and then, without any apparent reason at all, it suddenly jumps the wire, and bang she goes against the supporting side wires. Now, every time that trolley jumps the wire we estimate it costs us several dollars. Not that it injures the trolley-wheel materially, but because it weakens and loosens the whole overhead work for a hundred yards in either direction. Sometimes the pole strikes the supporting wires half a dozen times before the car is brought to a stop or the conductor succeeds in capturing the elusive trolley. We have devoted more attention to that trolley wheel than anything else on the system, and we can't remedy the evil. We have tried dozens, yes, scores, of different patents of trolley wheels, but not one answers the purpose. The swaying of the car is really the cause of the trolley jumping the wire, and this adds greatly to the friction. Some wheels cannot endure the strain imposed upon them, and they give out in two or three days. Others last for months. The only solution to our troubles is to adopt the underground system, and that, I think, we will come to before many years."

New England Notes.

BOYNTON BICYCLE RAILWAY.—The Legislative Committee on Street Railways has reported in the Massachusetts Senate a bill extending the time called for in the charter to build the Boston, Quincy & Fall River Bicycle Railway to July 1, 1900.

THE BELL TELEPHONE COMPANY BUYING PROPERTY.—The American Bell Telephone Company has within the past few days purchased the property at 11 and 13 Oliver Street, Boston, for the purpose of making room for the large and increasing business of the New England Telephone Company. The latter concern is very much crowded in its operating and executive departments in its present location at 125 Milk Street.

REPLACEMENT OF TRACKS ON TREMONT STREET, BOSTON.—The Board of Aldermen has formally resolved that public convenience and necessity require that the tracks formerly located on Tremont and Boylston Streets, and removed by the order of the Transit Commission soon after the completion of the subway, should be replaced. A copy of the resolution has been sent to the Legislature, which is now considering the subject.

BOSTON MOTOR CAB & OMNIBUS COMPANY.—A new corporation to run motor cabs, omnibuses and wagons in Boston has recently been formed, with a capital stock of $100,000. The company is authorized to do a common carrier business of persons and merchandise by automobile vehicles propelled by electricity, compressed air, or gasoline motors, and already has a petition before the Board of Aldermen asking for authority to run these vehicles over certain streets in the city.

THE BELL COMPANY TO MOVE TO NEW YORK.—It is reported that the directors of the American Bell Telephone Company have decided to remove the company's headquarters from this city to New York City. One of the probable reasons for this decision, if the report be true, may be found in the rumors that have been current lately regarding the intention of the company to move its official headquarters out of the State. This subject was particularly referred to in the New England correspondence in The Electrical World of January 21, 1899.

MAP OF STREET-RAILWAY LINES IN THE EAST.—Mr. R. H. Derrah, of the Boston Elevated Railway Company, Boston, Mass., has completed a map showing all existing and projected street railway lines in Massachusetts, Rhode Island and Connecticut, as well as steam roads. The map is drawn on a scale of 4 miles to the inch, is mounted on cloth and printed in five colors, the street railways being shown in heavy red lines. A vast amount of work was involved in the preparation of this map. There are 2157 miles of electric roads in the three States mentioned.

PRESIDENT M'KINLEY RIDES THROUGH THE BOSTON SUBWAY.—This great attraction of Boston was not omitted by President McKinley during his recent visit to Boston, and, accompanied by members of his cabinet, and escorted by Governor Wolcott and staff, the President was conducted through the subway by the Boston Elevated officials, in special private cars. Throughout the trip the President exhibited considerable interest in the great underground engineering work. His opinion of the Boston Subway was summed up in his remark, "It's a grand thing," made to Governor Wolcott at the completion of the trip.

CORLISS ENGINE COMPANY.—The Corliss heirs have transferred their right and title to the new Corliss Engine Company, which includes Joseph R. Hoadly, of the Hoadly-Leiter Syndicate, and several banks. There was a large cash consideration, and D. M. Thompson, of Providence, R. I., is to continue as president. It was rumored in Providence at the time of the deal that the Hoadly-Leiter Syndicate would absorb the Providence Locomotive Works, which was to be used as an automobile truck factory, to employ 1500 to 3000 hands; but it now seems that this deal is practically off. The Corliss Engine Company will manufacture steam engines only.

POSSIBLE TELEPHONE CONSOLIDATION.—It is reported here that there are prospects that the American Telegraph & Telephone Company, better known as the Long-Distance Company, will, before long, offer its stock in exchange not only for Bell shares, but for all the sub-companies, including the New England Telephone and Erie Telephone Companies. The Long-Distance Company is said to be paying 5 per cent. dividends and earning 8 per cent., but will probably offer its shares at $100 per share in exchange for the stock of the Bell Company and all sub-companies, thus making a gigantic telephone consolidation throughout the United States. The exchange, it is stated, will require an issue of at least $250,000,000 of capital.

ELECTRIC FREIGHT LINE.—The Massachusetts Legislative Committee on Street Railways has recently given a hearing on a bill to charter the Massachusetts Electric Freight Company. This bill gives the incorporators, James Means, Archibald M. Howe and others, of Brockton, Mass., the right to own and operate freight cars and freight motors over certain established street railways of the State. Mr. Means protests against the excessive freight rate charged by the Consolidated Road between Boston and Brockton, and the incorporators state that the street railways over which the freight cars would be run would be limited to lines between Boston, Brockton and Taunton. The capital stock is fixed at $150,000, of which $5000 is to be paid in. Colonel Benton, representing the New York, New Haven & Hartford Railroad, opposed the bill. He said that an analysis of it would show it faulty, and that it was a threat against the continuance and prosperity of every steam road in the State. The hearing has been continued in order to give the petitioners a chance to put in more evidence in its favor.

THE RECENT SNOWSTORM caused more delay to steam roads in this section of the country than to electrics. A number of trains were stalled on many of the steam roads on Monday night, February 13. The Boston Elevated Road, however, kept all of its lines open and in operation throughout the storm. One hundred and seventy-five plows were in use on Monday night keeping the lines clear. The Lynn & Boston Street Railway system was severely tied up at most all points, with the exception of the line from Chelsea to Boston. No damage was done, however, on any of the roads. General Bancroft, vice-president of the Boston Elevated Railway Company, thinks that the overhead trolley system is the most efficient under such conditions. The company employed 400 pungs of its own and hired 600 others, or sleds, for carting the snow away from the sides of the streets after being swept from the tracks. In this service 2200 horses were utilized. In some instances it was necessary to send men to shovel the snow where plows could not go unaided. The company, he said, was thoroughly organized and equipped to handle the snow, after the experience of the storm of last November. General Bancroft stated that it would cost the company about $150,000 to clear the road, but, he remarked, "We carried the people." There was practically no damage to telegraph or telephone lines in this section, both systems working uninterruptedly.

Philadelphia Note.

TRANSPORTATION PROBLEMS IN CITIES.—At the stated meeting of the Electrical Section of the Franklin Institute, which will be held in this city on the evening of February 28, Mr. Edward E. Higgins, editor of the "Street Railway Journal," New York, will read a paper entitled "Some of the Larger Transportation Problems in Cities."

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SOUTHERN NOTES.

A NEW TELEPHONE COMPANY IN HAYES, MD.—A company to be known as the Cranesville, Friendsville & Oakland Telephone Company has been organized at Hayes, Md. The company is constructing a line 25 miles long, and when completed will begin on a 40-mile line.

RAILWAY FRANCHISES REVOKED.—The City Council of Newport News, Va., has unexpectedly revoked the franchises of the Newport News & Old Point Railway & Electric Company, held under the two ordinances recently adopted. No one understands exactly why the action was taken at this particular juncture, and about the only thing that is understood about the situation is that the commonwealth's attorney urgently requested it, representing that it was necessary in the successful prosecution of the injunction suit against the street railway company.

TELEPHONE EXTENSIONS.—Mr. H. P. Miller, special agent for the Bell Telephone Company, is in Charlotte, N. C., looking to the establishment of a private branch exchange in that city for the Atlantic Coast Line Railroad. The Bell company is now at work on the line from Charlotte to Salisbury; also between Columbia and Charlotte and Charleston and Columbia. Savannah and Augusta and Charleston and Columbia will be connected within four months. These connections will complete the service north, south, east and west, and only a line from Wilmington to Charlotte will be needed to enable patrons of the Bell company to communicate with every city in the United States reached by the long-distance lines.

CONCERNING CONSTRUCTION BIDS ON THE MOSCOW (RUSSIA) ELECTRIC RAILWAY.—Recent advices received in Washington from Moscow state that the City Council of Moscow will publish in Russian and foreign newspapers a statement advising all contractors who are desirous of bidding for the construction of electric railroads in the city to make applications to the City Council not later than April 12. The sum of 750 rubles ($375) must accompany each application. The Council will give all parties presenting applications the terms and conditions of the concessions, with all necessary drawings and statistics as to the working of the tramways in Moscow for the past five years, profits of the different localities, list of lines existing, and approximate prices for making out the estimates. For foreign bidders there will be issued copies of the contracts printed in foreign languages, which will be sent on demand to all electrical companies. Copies will be sold to all applicants desiring particulars of the contract to be issued. The date of presenting the final tenders will be October 1, 1899.

CHICAGO NOTE.

TELEPHONE WAR IMPENDING.—Chicago is in the throes of a lively telephone war. A few weeks ago the combination of capitalists which is back of the Kellogg Switchboard Company, of Chicago, and the Kinloch Telephone Company, of St. Louis, had an ordinance introduced into the City Council granting a fifty-year franchise to the Illinois Telephone & Telegraph Company. The ordinance provided for new exchanges, conduits in all streets and alleys, and subscribers throughout the city. It was passed by the Council, but vetoed by Mayor Harrison on account of length of grant and absence of compensation clauses. While a second ordinance was being prepared to meet the mayor's views the existing Chicago Telephone Company came forward with an ordinance introduced in the Council asking for an extension of its franchise, and proposing a change to a graded system of charges according to number of calls. The present ordinance under which the Chicago Telephone Company is operating has yet ten years to run, but an extension of twenty years further was asked for. A new schedule of prices, based on a charge of 10 cents a message, was proposed. Telephones limited to 900 outgoing calls yearly were to be charged $90, 600 outgoing calls $60, and so on. Calls over the number fixed were to be charged extra, at a rate of about 8½ cents a call. The company also asked to change its present 3 per cent. compensation to the city to $50,000 a year. This ordinance was reported out of committee at the same time as the revised ordinance of the Illinois Telephone & Telegraph Company. A long defence of its ordinance was printed by the Chicago Telephone Company in all the newspapers, telling the reasons why it asked for an extension at this time, and what benefits the new graded rates would bring. This was replied to by the solicitor for the Illinois Company, Charles H. Aldrich. The concluding paragraph of Mr. Aldrich's open letter read as follows: "The ordinance (Chicago Telephone Company's) is well calculated to increase the profits of the overgrown, conscienceless monopoly, and brings no relief whatever to the public. It is not entitled to the favorable consideration of any sincere man." The two ordinances came before the Council Wednesday evening, February 15. The revised ordinance of the Illinois Company was passed. The mayor has stated he will sign it. It provides for a life of thirty years, covering all the territory inside the city limits of Chicago. The compensation to be paid the city is nothing for the first ten years, 3 per cent. of the gross receipts for the second ten years, 5 per cent. for the next five years, and 7 per cent. for the remaining five years. In the territory bounded by Fullerton Avenue, Western Avenue, Twenty-second Street, Halsted Street, Fifty-fifth Street and the lake all wires are to go underground. In all conduits one duct shall be given to the city, and the city can use all the company's poles. If the company does not have an exchange with 2000 subscribers in operation within five years the franchise is forfeited. The cost of telephones shall not be more than $85 a year for business instruments, $50 for residences, and $125 for public telephones. The city is given a number of telephones free, and can rent instruments for fire and police use for $5 a year. An option is given the city to purchase the plant at the expiration of the franchise. The new company will use the Kellogg switchboard patents, and will proceed at once to lay wires and establish an exchange in the downtown district. It is prevented by its ordinance from consolidating with the Chicago Telephone Company, and its officials say they have no such idea in view. From all indications Chicago is likely to have two telephone systems within a few months.

INDIANA NOTES.

INDEPENDENT TELEPHONE SYSTEM FOR RICHMOND.—J. M. Lantz and others have secured a franchise to operate an independent telephone exchange at Richmond.

TELEPHONES IN SCHOOLS.—The Indianapolis School Board has contracted with the New Telephone Company for sixty telephones at an annual rental of $24 each, for the use of the public schools.

THE HOME TELEPHONE COMPANY, at Wabash, has not only reduced the rates from $48 and $36 to $12 and $9 per year, but has declared a dividend. It operates 300 telephones against 120 by the Central Union.

RAILWAY FRANCHISE GRANTED.—A franchise for an electric railroad from Richmond to Connersville has been granted to and accepted by William A. Pickens, of Indianapolis, and Noah Clodfelter, of Anderson, and a $5000 bond filed.

THE UNION TRACTION COMPANY, of Anderson, has secured a franchise over the public highways to the Delaware County line to connect with the Muncie end. Also a franchise over the highway in Madison County toward Indianapolis.

ELECTRIC RAILWAYS ON PUBLIC HIGHWAYS.—A bill has been introduced in the Indiana Legislature prohibiting boards of County Commissioners from granting rights of way to electric railway companies over public highways. The bill will not meet with favor.

BILL TO PROTECT ELECTRICAL INTERESTS.—A bill has been passed by the House to protect companies engaged in the manufacture of electricity for lighting and power purposes and to prevent the unlawful diverting and use of such electricity.The Senate is said to be favorable to the bill also.

TO EXAMINE PIPES IN INDIANAPOLIS.—C. E. Brownell, an electrical expert, of Dayton, Ohio, has been employed by the Indianapolis gas and water companies to make an examination of the pipes to ascertain the extent of damage done by electrolysis. Grave fears are entertained because of the network of pipes in the city.

TO FACILITATE THE COLLECTING OF JUDGMENTS.—A bill has passed the Senate to make it easy to collect a judgment against any railroad company. It provides that when a judgment is outstanding against a railroad or street railroad company the agents or conductors shall pay all moneys collected directly into court to satisfy the judgment. So that if a railroad company takes in any money at all the collection of the judgment, or at least a part of it, is certain.

THE INDIANAPOLIS STREET RAILWAY SITUATION.—There is an entirely new phase to the Indianapolis street railway situation. There has been a number of years of intricate and exasperating litigation. The highest court of the State decided by a majority vote that the Citizens' Company's franchise expired in 1901, and that the City Company's franchise to certain streets was valid. The new court, upon proper petition, granted a rehearing, which was regarded as equivalent to holding that the City Company's franchise was ineffective and void, and that the Citizen Company's rights would expire in 1901. Thereupon G. A. McGowan, of Kansas City, came to Indianapolis and effected a reorganization of the Citizens' Street Railway Company, and has purchased the franchise of the City Company. This leaves the Citizens' Company in sole control until 1901. A bill has been introduced in the Legislature making it possible for a reasonable settlement of all the antagonizing interests and leaving everything in readiness for a new franchise or contract between the Citizens' Company and the city of Indianapolis. In the reorganization Mr. McGowan has elicited the interest and capital of a number of prominent citizens of Indianapolis, and one of the number, Mr. H. P. Wasson, is to be president of the company. The sole question now is the terms of settlement for new lease of life. The new company has made the city an offer of $1,500,000 for a thirty-four-year franchise. This does not appear satisfactory to the city, or to the citizens thereof. The feeling is for a 3-cent fare and a good percentage of the gross receipts. The $1,500,000 was to be paid in installments of $200,000 every five years.

ST. LOUIS NOTES.

TO SUBSTITUTE ELECTRIC POWER FOR BROADWAY CABLE.—It is stated that the Broadway cable line will soon be converted into an open electric conduit road. The system will then be the first of this class in St. Louis, and the longest straight line of street railway in the United States.

THE PEOPLE'S RAILWAY was sold last week to August Gehner, representing the third mortgage bondholders, for $500,000. The representatives of Mr. Charles Green notified the trustee, Mr. C. C. Maffitt, that he would file a motion to have the sale set aside, which he afterward did, the exceptions alleging that the sale should have been postponed because of the inclemency of the weather.

SALE OF THE SCULLIN LINES of street railway in St. Louis to Brown Brothers, of New York, is announced. It is stated that the price agreed upon was on a basis of $130 a share. The Union Depot Company is capitalized at $14,000,000, and has $1,000,000 consolidated mortgage 10-20 bonds issued in 1890, which bear 6 per cent. interest. The total amount authorized at the last issue was $3,500,000, but $1,300,000 was still in the treasury of the company. A large outlay will be necessary to put the roads and equipment in good repair. It is reported that the company will be reorganized and the entire network of lines run under one management. The new company will be named the St. Louis Traction Company, or the Lindell Traction Company. The Scullin system embraces 90 miles of road.

PACIFIC COAST NOTES.

THE STANDARD ELECTRIC COMPANY, of California, was recently reincorporated, with a capital stock of 5,000,000, by John S. Drum, F. H. Dam

and others, for the purpose of building electric plants, etc. It was formerly incorporated under the laws of West Virginia.

THE PACIFIC ARC LAMP COMPANY, San Francisco, has removed its factory to 149 Fremont Street, where an improved lamp is being made with enlarged facilities. The Northern Electrical Manufacturing Company's motors and the Hardy incandescent lamps are kept in stock by the company.

TO ENLARGE AND IMPROVE A FRESNO PLANT.—It is announced that the Fresno Gas & Electric Company, of Fresno, Cal., has borrowed $50,000 through the California Safe Deposit & Trust Company, securing the same by a mortgage upon its plant and franchise. The money will be used in enlarging and improving the plant, etc.

A WATER POWER WANTED FOR TACOMA STREET RAILWAYS.—The Tacoma Railway & Power Company, which was recently incorporated with a capital of $2,000,000 to take over all of the street railways in the city of Tacoma, Wash., has instructed Superintendent Frank L. Dame to secure an available water power for an electric power-transmission system.

PORTLAND REPUDIATES ITS LIGHT CONTRACT.—The Board of Public Works of Portland, Ore., has notified the corporation which lights the city that the contract made by the City Council providing for lighting the city for two years yet to come would not be regarded by that body as valid or binding. The company was also warned to furnish no lights after March 31, 1899, when the present contract expires, unless some new arrangement shall be made. The resolution passed forbids the clerk of the board from expending in any year for street lighting any sum in excess of 1½ mills on the dollar on the taxable property. This rule would limit the annual expenditure for lighting to $57,594.

Canadian Notes.

AUTOMOBILE AMBULANCES.—A movement is on foot in the city of Toronto to have all the ambulances of the city fitted out with electric motors and do away with horses altogether. This proposition is advanced on the ground that ambulances could be worked with greater expedition.

AN EXCLUSIVE FRANCHISE IN HULL.—The Court of Appeal in Montreal has rendered an important judgment in the case of the Hull Electric Company v. the Ottawa Electric Company. The result of the judgment is that the Ottawa company will be compelled to remove its poles from the streets of Hull, Que. The plaintiff company, by virtue, of a by-law of the city of Hull, claimed a monopoly of erecting poles and conducting the electrical business in that city, and judgment was given in its favor. The exclusive franchise of the latter company is thus declared legal.

A 19-MILE TRANSMISSION PLANT.—The town of Orillia, Ont., passed a by-law authorizing the issue of debentures for $75,000 for the purpose of installing an electrical transmission power plant. With this sum it is proposed to bring 800 horse-power from the Ragged Rapids on the Severn River, a distance of 19 miles overland. The contract has already been awarded to the Central Construction Company, of Buffalo, whose tender of $67,200 for the complete plant, electrical and hydraulic, was the most satisfactory of those submitted. The power will be transmitted at 20,000 volts. It will be used for running the electric light and waterworks plants, which are owned by the town, and for supplying private power-users. This town will be the first municipality, it is said, on this continent to install an electric plant of its own for the purposes mentioned. It will be able to sell electrical power as low as $13.50 per horse-power per annum.

French Notes.

INTERNATIONAL CONGRESS OF PHYSICISTS IN 1900.—The Physical Society has voted to hold an international congress of physicists in 1900. The meetings of this congress will be held in the buildings erected for such purposes, within the exposition grounds, from Monday, July 16, to Saturday, July 21, 1900. The Executive Committee decided that the society would not take any part in the exposition as an exhibitor.

WIRELESS TELEGRAPHY.—At the last meeting of the Physical Society M. Ducretet showed his portable receiver for Hertz signals; it a modification of Mr. A. Popoff's. The recording mechanism has been omitted, and the signals are read by ear; but it is arranged so that it can be connected with any form of recording apparatus. This portable instrument comprises a Branly coherer (Ducretet's modification with ivory tube and regulator), equipped with an automatic tapper controlled by a sensitive relay in circuit with the tube of metallic filings. A liquid resistance obviates the effect of the spark at the contact breaker. The battery is hidden. This form of instrument connected to a Morse recorder was used with signals transmitted from the Eiffel Tower to the Pantheon, in the presence of M. Mascart. Owing to its certainty of action it is particularly well adapted for use in experimental demonstrations. M. Dussaud, who made a careful study of this apparatus, says that M. Ducretet is much too modest about it; that it amounts practically to a new invention, being vastly superior to the German instruments used for lecture purposes.

THE VIALET-CHABRAND SIGNAL INDICATOR FOR USE ON SHIPBOARD.—A recent invention of Vialet-Chabrand, chief electrician at the Compagnie des Messageries' Ship Yards, in La Ciotat, is one of unusual importance to the shipping world, relating as it does to the transmission of signals on shipboard. M. Vialet-Chabrand's electric transmitting apparatus enjoys an advantage in the ease with which an electric cable can be laid between the receiving and transmitting points, as compared with the difficulty of rigging up the rods, chains, gears, etc., necessary with the other system. Moreover, this complicated gear introduces friction and liability to alternations and breakages, which may alter or interfere with the signals. For use on warships the Vialet-Chabrand apparatus is provided with a switch to throw a battery in circuit in place of the dynamo current, which might be cut off during a fight, as the result of injury to other circuits. In addition to the signaling devices for transmitting orders, the apparatus shows also, whether the order is being obeyed properly or not, so that an error is detected at once. The inventor has improved on his first instruments by the addition of new devices which permit the officer in charge on the bridge to control the direction of motion and the speed of the engines. This apparatus has been in use for some time on some of the large boats of the Compagnie des Messageries, and it has been found satisfactory in every way. The Minister of the Navy has recently authorized a trial of the inventions on a war vessel, and experiments have been made with it on the "Courbet," but owing to the departure of the latter for the North Atlantic Squadron these experiments will be continued on the "Bremens," the flagship of Vice-Admiral Tournier, commander of the Mediterranean Squadron.

THE ACTION OF THE COHERER EXPLAINED.—M. Brosca, before the Paris Physical Society, described briefly the results of M. Arons' research on the coherer. He said many unsuccessful attempts have been made with the help of the microscope to discover what goes on in the filings of a coherer. M. Arons made an experimental coherer from which he was able to get a perfectly regular action. It consisted of two pieces of tin-foil cut to sharp points and glued to glass, the points being placed opposite each other and very close together. This arrangement was observed with a microscope, giving an enlargement of from 60 to 85 times. Very fine filings were introduced in the space between the pieces of tin-foil. When conductivity is established very small sparks are seen to jump from one grain of metal to another, and considerable movement takes place. The filings range themselves into trains, bridging the space and making a good conductor for the current. These bridges become broken into their component parts by a tap, restoring the state of high resistance. Experiments were made with brass, silver and iron filings. Brass sometimes makes bridges of sufficient strength to resist the effects of tapping, which makes it unsuitable for this use. Experiments were made also on substances confined in Canada balsam. Much the same phenomena were observed, but it is necessary to use pressure to return the conditions of high resistance, tapping not being sufficient. When a preparation of this sort has been in action steadily for some little time it finally refuses to function. Careful observation discloses the formation of small gas bubbles, which, in a few hours, are reabsorbed, the apparatus returning then to the working condition. M. Arons discovered two additional facts of interest. First, that very strong waves will break up the little bridges, which close the circuit, a fact which has hitherto escaped observation on account of the large dimensions of the ordinary coherer when compared with M. Arons' apparatus; in the former new bridges form at the same time that existing ones are broken up. In the second place, he noticed that with his two pieces of tin-foil, with points very close together, conductivity may be established simply by the deposition of tin volatilized from the electrodes and forming an extremely thin brown skin. No amount of tapping will interrupt the conductivity so established. He deduces from his experiments that the action of the coherer is due to the extreme sharpness of the metal filings. The actual energy expended is very small, but the specific energy acting on these fine points is great enough to produce fusion, volatilization and chemical decomposition.

General News.

New Incorporations.

THE WINCHESTER, FORD & RICHMOND TELEPHONE COMPANY, of Pine Grove, Ky., has been incorporated with a capital stock of $600. David Prewitt is the chief incorporator.

THE BENBOW ELECTRIC COMPANY, Cambridge, Ohio, has been formed with a capital stock of $5000. The incorporators are William C. Benbow, Nathan H. Barber, James A. Weyer, H. O. Barber and Charles Mart.

THE DUBLIN ELECTRIC COMPANY, Dublin, N. H., has been formed with a capital stock of $5000. The incorporators are Charles F. Appleton, Charles J. Ellis, George W. Gleason, Henry D. Larned and Arthur O. Mason.

THE CAMBRIDGE ELECTRIC ENERGY COMPANY has been incorporated at Cambridge, Ohio, with a capital stock of $25,000. Those interested are Nathan H. Barton, John C. Buskett, H. A. Patterson, H. O. Barber and William C. Benbow.

THE ST. REGIS FALLS ELECTRIC LIGHT COMPANY, of St. Regis Falls, N. Y., has been incorporated with a capital stock of $2,000. The directors are H. E. O'Neill, William T. O'Neill and William B. Babcock, St. Regis Falls.

THE MISSOURI ELECTRIC RAILWAY COMPANY, Kansas City, Mo., has been incorporated with a capital stock of $500,000. Among those interested are H. Smith, Frank Sears, C. McDonald, B. F. Burd, W. H. Brown, J. J. Hover, H. G. Lightner, S. B. McMott and O. M. McDonald.

THE RICHMOND, OXFORD, REILEY & CINCINNATI ELECTRIC RAILWAY COMPANY, Reiley, Ohio, has been incorporated with a capital stock of $3000. The incorporators are Caleb A. Shera and A. F. Sloan, of Oxford; J. F. Gillespie, H. H. Smith, M. E. Fye, H. L. Roll and J. M. Duncan.

THE ILLINOIS DISTRICT TELEGRAPH COMPANY has been incorporated at Springfield, Ill., with a capital stock of $100,000. The headquarters of the company will be at Chicago, and the incorporators, who are all officials of the Western Union Telegraph Company, are F. H. Tubbs, president; E. M. Mulford, Jr., manager, and William J. Lloyd, assistant superintendent.

THE NORTH VERSAILLES TOWNSHIP LIGHT & POWER COMPANY, of North Braddock and Turtle Creek, Pa., has received its charter of incorporation, and will, it is said, build a modern plant of large proportions at Wilmerding. The officers of the new company are: E. W. Boyd, president; Grant Williams, treasurer; Anthony Lewis, secretary, and D. A. Powell, solicitor. The company is capitalized at $15,000.

THE EAST JERSEY ELECTRIC COMPANY has been incorporated at Trenton, N. J., with a capital stock of $1,000,000. The company is empowered to manufacture and deal in electricity, light, heat and power of all kinds, including compressed air. The incorporators are Charles F. Johnson, of New York; S. Hand Taylor, of Philadelphia, and Joseph P. Cooper, of Rutherford, N. J.

THE TELEGRAPH AND TELEPHONE.

PHILADELPHIA, PA.—The Chester County Telegraph & Telephone Company has decided to increase its capital from $30,000 to $75,000.

ALBION, MICH.—It has been announced that a local company will be formed to take charge of the interests of the Calhoun County Telephone Company. The new concern will be known as the People's Telephone Company.

PADUCAH, KY.—The East Tennessee Telephone Company is now taking contracts for residence telephones at 50 cents per month. The company is erecting a new exchange building, which will be equipped with modern apparatus; the central-energy system will be adopted.

PROVIDENCE, R. I.—The Massachusetts Telephone & Telegraph Company, of Boston, has petitioned the Board of Aldermen of this city for permission to locate poles and wires for a complete telephone system here. The petition recites that the system will be connected with a long-distance line between Boston and New York.

ALBANY, N. Y.—A resolution has been introduced in the Assembly providing for the appointment of a committee of seven members to examine into and ascertain the receipts and expenditures of the Bell Telephone Company and the amount of capital invested and dividends paid for the period of the existence of said company as will enable the Legislature to judge what would be proper and reasonable rates for telephone charges by the company.

HARTFORD, CONN.—A bill for the incorporation of the Boston & New York Telephone Company has been introduced in the Connecticut Legislature. The capital stock is to be $3,000,000, and the incorporators are Gen. E. E. Bradley, of New Haven; John W. Seymour, of Norwalk; Oakes Ames, Chas. E. Adams and E. S. Holbrook, of Boston; W. H. Brown, of New York, and Col. John W. Rutterfoord, of Philadelphia. The bond issue will probably approximate $1,000,000. It is said to be the purpose of the company to build a trunk line between Boston, New York, Philadelphia and the West, and to establish exchanges in different places.

JERSEY CITY, N. J.—Mr. G. H. Atkinson, of the Telephone Development Company, of this city, has started telephone systems in Monmouth County, a large part of which is being rapidly covered. The Independent exchanges at Newark, Trenton and Jersey City are the result of Mr. Atkinson's enterprise. He is now at work trying to effect a connection of the Monmouth and Somerset County systems with Trenton, and if he is successful there will be upwards of 3500 "independent" subscribers in the State. In this same field, when Mr. Atkinson began his work, the Bell Company had about 2400 subscribers. The Jersey City "Journal" has retracted its recent charges against Mr. Atkinson.

CHICAGO, ILL.—The ordinance giving the Illinois Telephone & Telegraph Company the right to operate a telephone system in this city was passed by the City Council on February 16. The franchise covers a period of thirty years. The city will receive no compensation during the first ten years, but after that it will receive 3 per cent. of the gross receipts during the second ten years, 5 per cent. during the next five years, and 7 per cent. for the remaining five years The option is given the city to buy the plant at the expiration of the franchise. The city will be given a number of telephones free, and can rent instruments for fire and police use for $5 per year.

SPRINGFIELD, ILL.—A bill has been introduced in the Legislature which, if enacted, will place telephone companies on the same basis as common carriers. It also provides that these companies must permit connections to be made between one another's systems and lines. The bill fixes rates as follows: In cities of over 100,000 inhabitants, $5 per month for business and $2 a month for private instruments; in places of less than 100,000 inhabitants, $2 per month for business and $1 for private telephones. For long-distance conversations the rate is fixed at 25 cents for five minutes, for a distance of 50 miles, and one-half cent a mile for each mile over 50.

UTICA, N. Y.—At the recent annual meeting of the Central New York Telephone & Telegraph Company, held in this city, it was shown by the report submitted that the gross revenue for the year was $234,086.53; expenses, $189,688.73; net revenue, $44,397.80. The company has 4013 subscribers, a gain of 387 during the year. Dividends at the rate of 6 per cent. per annum were paid. New exchanges have been opened at Baldwinsville, Boonville and Lowville, and new lines have been built in various directions. The following named gentlemen were elected officers for the ensuing year: Robert S. Williams, president; Lewis H. Lawrence, vice-president; Francis G. Wood, secretary and treasurer; and Charles A. Nicholson, general manager.

WASHINGTON, D. C.—Senator Frye has proposed an amendment to the Sundry Civil bill, authorizing the payment of a subsidy not exceeding $100,000 a year for the maintenance of a telegraphic cable from the United States to Hawaii, Manila and Japan. The contract for the laying of the cable is to be awarded to the lowest responsible bidder, with the provision that it shall be an American company. The subsidy is to run for twenty years, and during that time and thereafter cablegrams sent for the Government of the United States are to be transmitted free of cost. The commercial rate per word is fixed at 25 cents to Hawaii, 75 cents to Manila, and $1 to Japan, with press rates one-quarter of these. A provision is included requiring that the cable to Hawaii shall be completed by July 1, 1900, and to Manila by January 1, 1901. No company is named in amendment, as in other bills on the subject.

ELECTRIC LIGHT AND POWER.

EAST CHICAGO, IND.—An electric light plant is to be established in this city, and the power will be furnished by two 125-hp engines built by the Ball Engine Company, Erie, Pa.

RICHMOND, VA.—This city was in darkness on the night of February 17 on account of the flood in the James River. The water flooded the power plants and caused the stoppage of both the lighting and street railway services.

NEWARK, N. J.—It is stated that the five electric light companies which now separately supply gas and electric light to the cities of Paterson and Passaic, will be combined at a meeting to be held on February 28. The stockholders of the different concerns have been asked to sanction such action.

NORTHVILLE, N. Y.—Messrs. Eugene D. Scribner and George R. Scribner, comprising the Northville Electric Light & Power Company, have sold their electric light plant, located at Northville, N. Y., to George E. Van Arnam, John A. Willard, William Harris, Scott Partridge and Samuel Harris, all of the same place.

DENVER, COL.—It is stated that a syndicate composed of Messrs. Moore & Schley, Emerson McMillin, H. B. Hollins & Co., Wood & Havemeyer and John C. Tomlinson has secured control and will consolidate the gas and electric light properties of Denver. The Denver Consolidated Gas Company, of Denver, and the Denver Consolidated Electric Light Company will be combined, and the new company which will be organized will be authorized to issue $2,500,000 stock and $5,500,000 fifty-year gold bonds.

OBERLIN, OHIO.—The Oberlin Bank Company's vault was entered by burglars on the morning of February 17 by means of electric current taken from a trolley wire running along the street. The robbers tapped the wire and carried the current into the bank for the purpose of operating an electric drill at the outside door of the vaults. Through the hole made by the electric drill they inserted a charge of powder, which, on exploding, blew the interior of the vault into pieces. The burglars, however, obtained no reward for their trouble, as they failed to get into the large safe, evidently for the lack of time.

HONEY GROVE, TEX.—The Honey Grove Electric Light Department has issued the following schedule of rates for electric lights:

Commercial Rates. 12 o'clock schedule.	16-cp. lamps.	Residence Rates.	Commercial Rates. 12 o'clock schedule.	16-cp. lamps.	Residence Rates
1 light	$1.00	$ .75	7 lights	$5.95	$2.50
2 lights	1.95	1.25	8 lights	6.60	2.75
3 lights	2.85	1.50	9 lights	7.20	3.00
4 lights	3.70	1.75	10 lights	7.75	3.25
5 lights	4.50	2.00	11 lights and over, per light		.75
6 lights	5.25	2.25			

ALL NIGHT SCHEDULE.

1 light	$1.50	10 to 15 lights	$4.00
2 lights	2.35	15 to 20 lights	4.50
3 lights	3.50	20 to 30 lights	5.00

ARC LIGHTS.

Commercial lights, 12 o'clock schedule	$6.00	Charge for putting in each light	$5.00
Commercial lights, all-night schedule	10.00		

The department charges $1.25 per light for open wiring, and $.01 per hour for meter. For concealed wiring there is no fixed price.

THE ELECTRIC RAILWAY.

WHITE PLAINS, N. Y.—The Westchester County Electric Railroad Company has filed notice of its intention to extend its lines in Pelham.

PORT HURON, MICH.—The Rapid Railway Company has purchased the St. Clair River Road from Chesterfield to Marine City, and will equip it with electric power.

QUINCY, ILL.—There is some talk of building an electric railway from this city to Keokuk, Ia. It is estimated that the cost of the road will be $10,000. Mr. C. T. Dazey is a promoter of the enterprise.

LEXINGTON, KY.—The local street railway interests of this city have been practically consolidated. The new company just incorporated is named the Lexington Railroad Company, and has a capital stock of $800,000.

COLUMBUS, OHIO.—There is some talk of building a street car line between this city and Arlington. It is stated that four companies now have in contemplation such a line. Mr. H. C. Geise, of Arlington, is interested in the movement.

KENOSHA, WIS.—A company has been organized here to build an electric railway from this city to Pleasant Prairie, a distance of 6 miles, west. Vice-President Bishop, of the Milwaukee, Racine & Kenosha Electric Line, is said to be one of the promoters of the new enterprise.

PETERSBURG, VA.—It is rumored that the Piedmont Traction Company and the Virginia Electric Company, both of which control the street railway lines of this city, have been purchased by John L. Williams & Sons, of Richmond, and Mittendorf, Oliver & Co., of Baltimore. It is said that the two companies will be consolidated and the service improved.

CHICAGO, ILL.—The Chicago Consolidated Traction Company has been organized in this city with a capital stock of $15,000,000 for the purpose, it is stated, of uniting all the outlying street railway lines of the Yerkes' system under one management. The new company will include all of the electric roads in the country except those of the Chicago City Railway Company and that of the Calumet Company.

INDIANAPOLIS, IND.—The County Commissioners have granted a fifty-year franchise for an interurban line of electric railway to Messrs. D. P. Irwin, Daniel Ransdell and David M. Parry. The line will be built along the National Road from the west boundary of the city to the west county line, and work must be commenced not later than September 1 next, and the road be in complete operation by September 1, 1901, under penalty of forfeiture of charter.

PITTSBURG, PA.—It is reported that a combination of all the natural gas, illuminating gas, electric light and a portion of the electric traction interests at Pittsburg was effected here on February 16. The new concern is known as the Philadelphia Company, and will transact the business under the charter

of the old Philadelphia Company, a natural gas concern, which has an omnibus charter It is stated that Messrs. Alexander Brown & Sons, of Baltimore, financed the combination.

PHILADELPHIA, PA.—The heavy snowstorm of February 13 tested the trolley service of this city severely. After two days and nights of continuous operation of snow plows and sweepers, the storm got the upper hand and caused a hopeless tangle of the system. Cars were stranded in every direction, and it was only with difficulty that they could return to the barns. The company employed more than 500 carts in carrying the snow away from the tracks after being removed therefrom by the sweepers.

WHITMAN, MASS.—The new electric railroad which is to connect Brockton with Plymouth, a distance of 22 miles, will be constructed during the spring by a new company, which is backed by Boston financiers. The company has purchased the stock of the Plymouth & Kingston Road, in order to secure entrance to Plymouth. It is thought that the necessary franchise in Whitman will be granted without opposition. The directors of the new company are: John P. Morse and Henry B. Rogers, of Brockton; E. J. B. Huntoon, of Canton; Dr. H. W. Copeland, of Whitman; Arthur L. Gurney, of Hanson; Frank Bourne, of Halifax, and N. M. Drake, of Plymouth.

Legal Notes.

RIDING ON PLATFORM.—In an action by J. W. Lauer against the Terre Haute Street Railway Company, where it was shown that soon after he had stepped out on the rear platform another car ran against the one on which he was standing, crushing the platform and injuring him. The evidence showed that the conductor had requested the men in the car to surrender their seats to the ladies. The court, in affirming a jury verdict in favor of Lauer, said: "When a passenger in a crowded street car surrenders his seat to a lady and retires to the platform he is entitled to all the rights of a passenger; and if an accident, due to the negligence of the company's employees, occurs by which only passengers on the platform are injured, the company is liable."

MOTOR SUSPENSION INJUNCTIONS.—Judge Lacombe, in the United States Circuit Court for the Southern District of New York, on February 3, granted a preliminary injunction against the Yonkers Railroad Company, enjoining it from the further infringement of the Sprague patent, No. 324,892. The judge further ordered that the infringing apparatus be removed from the company's cars within thirty days. The complainant in this case was the Sprague Electric Railway & Motor Company.

An injunction has been issued against the Nassau Electric Railroad Company by the United States Circuit Court for the Second Circuit and Eastern District of New York, in favor of the Sprague Electric Railway Motor Company, enjoining the defendant from the further infringement of the Sprague patent, No. 324,892. The injunction is suspended so far as provided for in the order of the same court entered in the same suit on January 30 last.

SERIES-PARALLEL CONTROLLER INJUNCTIONS.—Judge Thompson, in the United States Circuit Court, at Cincinnati, Ohio, on February 6, in the case of the Thomson-Houston Electric Company and General Electric Automobile Company v. the Steel Motor Company and the Johnson Company, ordered a preliminary injunction against the defendants, enjoining them from making or using "any combination of electric railway motors and motor-circuits and resistances combined with controllers," embodying the inventions and improvements recited in the Condict patent No. 393,323.

Judge Lacombe, in the United States Circuit Court for the Southern District for New York, on February 3, issued a preliminary injunction against the Yonkers Railroad Company, enjoining it from making or using the same devices as those referred to in the case above mentioned. The complainants in this case, which also involves the Condict patent No. 393,323, are the same as those above referred to. Judge Lacombe further ordered the suspension of operation and removal within thirty days of the infringing equipments already in use.

WAS NOT A PASSENGER.—The Supreme Court of Indiana has just rendered an important decision in the case of Udell v. the Citizens' Street Railway Company. The suit was brought five years ago to recover damages for the loss of a leg. Udell was at the time of injury eight and a half years old. He climbed on a car, from the left side, at a summer park, and rode standing on the boxing which covered the end of the axle of the car, holding to the side of the car with his hands, and crouching down so low that the conductor did not see him. He had a nickel in his pocket with which to pay his fare if asked for, but he fell off before the conductor got to him. The case was tried twice in the trial court, the first trial resulting in an assessment of $11,500 damages by the jury; but the jury was unable to say whether he intended to pay his fare when he boarded the car. For this reason a new trial was granted. At the second trial the jury brought in a verdict for $10,000, but found facts from which the court decided that he was not a passenger and pronounced judgment for the defendant. The plaintiff appealed, and Judge Downing, in affirming the judgment, said: "The circumstance that appellant had a nickel in his pocket with which to pay his fare—when called upon—did not make him a passenger. If he did not intend to pay his fare unless called upon, and left the car, or attempted to leave it, without paying his fare, that fact of itself would be entitled to weight in determining the question of his right on the car. He was not in a place intended for passengers, nor was he received as a passenger. The fact that appellant was a child did not make him any less a trespasser."

Obituary Note.

MR. EDWIN STANTON CARPENTER, assistant treasurer of the Westinghouse Electric & Manufacturing Company, died in New York last week, at the age of thirty-seven years. His remains were taken to Pittsburg on February 16 for interment.

Trade and Industrial Notes.

THE BALL ENGINE COMPANY, Erie, Pa., has recently supplied to the electric company at Lansdale, Pa., a 100-hp engine.

THE POWER AND MINING DEPARTMENT of the General Electric Company has now under construction twelve electric locomotives for domestic use.

THE FULLER COMPANY, Detroit, Mich., states that its fans are meeting with great success, and that its works are running to their fullest capacity. The Fuller fan was described in The Electrical World of January 7.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., calls attention to the fact that it is not too early for the alert station manager to make preparations for protection against lightning during the early spring storms.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY has received a contract to supply the apparatus and appliances for the Mount Whitney Power Company, of Visalia, Cal. The equipment will cost, it is stated, about $300,000.

MESSRS. J. H. BUNNELL & CO. inform The Electrical World that the death of Mr. Jesse H. Bunnell will not interfere with the business, which will be carried on as usual under the old title and at the old stand, 76 Cortlandt Street, New York.

MESSRS. CHARLES A. BESLY & CO., 10 and 12 North Canal Street, Chicago, state that they are receiving numerous large orders for their Helmet oil and "Perfection" and "Bonanza" oil cups. Several well-known industrial concerns are using these oils and oil cups on their machinery.

MESSRS. EUGENE MUNSELL & CO., of New York and Chicago, report a very gratifying demand for their India and amber "Mica," of which they make a specialty for electrical insulation. Some very large orders have been received at both their Chicago and New York addresses.

MESSRS. RYAN & FISHER, Pabst Building, Milwaukee, Wis., have purchased the Milwaukee X-Ray Laboratory, formerly conducted by Mr. Lynde Bradley, and are prepared to carry on radiograph work of all kinds. They have a large stock of very interesting negatives from which photographic prints can be furnished.

THE PEERLESS RUBBER MANUFACTURING COMPANY, 16 Warren Street, New York, states that its factory is being run day and night in order to promptly fill orders. The demand for its line of packings is constantly increasing. The company states that over 1500 tons of "Rainbow" packing were sold during 1898.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, in Catalogue No. 221, dated January, 1899, points out the special features and uses of its direct-current 250-volt engine-type power generators. The illustration of a 400-kw machine of this class is shown on the front page, and dimensional diagrams and other data are also given.

MESSRS. WARREN WEBSTER & CO., Camden, N. J., have recently made a large number of contracts for the installation of steam heating plants on the Webster system. Among them is one for the J. G. Brill Company, Philadelphia, Pa. The list of concerns giving these contracts covers practically every industry, and includes, besides, railroads and educational institutions.

THE PENCOYD IRON WORKS, Pencoyd, Pa., has received the contract for the construction of the Boston Elevated Railway structure in Washington Street and Main Street, Charlestown, Mass. The contract calls for the completion of the work by October 1, 1899. The length of this portion of the road will be 13,870 feet, and in its construction 8300 tons of metal will be required.

EXTRA HEAVY PRESSURE GATE VALVES.—Among the comparatively new lines of valves brought out by the Roe Stephens Manufacturing Company, of Detroit, Mich., are extra heavy pressure gate valves. These goods, it is stated, have met with an extraordinary demand during the active business of the past six months, both in government and private work, at home and abroad. They are used in a large number of the electric railway power houses and electric light plants, where high pressure is used, and in waterworks and other municipal plants.

THE CROUSE-HINDS ELECTRIC COMPANY, Syracuse, N. Y., has introduced a very unique method of advertising testimonials of the Syracuse changeable electric headlight, manufactured by this company. It consists of a portfolio, inclosing facsimile reproductions of letters from various railroads throughout the country, all testifying to the good qualities of the headlight and the satisfaction given in actual use. The portfolio is gotten up in very attractive form, and the testimonials will no doubt receive greater attention than they would if they were printed in cold type in the usual manner.

THE OPEN-CONDUIT ELECTRIC SYSTEM IN WASHINGTON.—In a recent letter from Mr. G. B. Coleman, general manager of the Metropolitan Railroad Company, Washington, D. C., to the General Electric Company, that gentleman gives expression of his satisfaction with the open-conduit system of traction, and its ability to cope with severe climatic conditions. Following is a copy of the letter: "Gentlemen—I telegraphed you to-day as follows: 'When will electric equipment for snow sweeper be shipped to Brill, Philadelphia? They are at a standstill for the want of it. We need the sweeper. Twelve inches of snow here; car schedule maintained through it all. Underground system best in the world.' I sincerely trust that you will hurry up the shipment of the motors for this sweeper, as it is of inestimable value to us in the event of a snowstorm. Washington has been visited by the severest snowstorm in years, there having fallen 12 inches of snow in the past three days. By constant and energetic work the tracks were kept clear and the cars running all the time. I cannot speak too highly of the General Electric Company's system, and if anybody desires to see a road successfully operated under adverse circumstances they should come to Washington in a big snowstorm."

DEVELOPING THE ST. ANTHONY'S FALLS POWER.—The equipment of the power house at the lower dam of the Falls of St. Anthony, at

Minneapolis, Minn., is about to be completed, and the necessary arrangements have been made by the St. Anthony Falls Power Company with the General Electric Company, which manufactured and installed the plant now in operation. The hydraulic work and the power house were finished in the spring of 1898, and five three-phase alternators of 700 kilowatts each, and two direct-current generators of the same capacity, with the necessary rotary converters and static transformers, were installed. The full equipment of this power plant as originally laid down contemplated the use of eight alternators and two direct-current machines of the total capacity of 10,000 horse-power. The present plant has been in full operation since May of last year, the current being used to drive the street and interurban railway systems of the Twin Cities' Rapid Transit Company, which operates the electrical railways of Minneapolis and St. Paul. The additional equipment will consist of three 700-kw, three-phase, revolving-armature alternators, with rotary converters, step-up and step-down air-blast transformers, and switchboards for the generators and converter. The installation of this machinery will increase the generating capacity to the 10,000 horse-power originally contemplated.

Directory of Scientific Societies, Associations, Etc., and Meetings of the Same.

FRANKLIN INSTITUTE (Electrical Section), Philadelphia, Pa.—Secretary, William H. Wahl.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA, Pittsburg, Pa.—Meetings, third Tuesday of each month.

THE NEW YORK ELECTRICAL SOCIETY.—President, Gano S. Dunn; secretary, George H. Guy, 120 Liberty Street, New York.

HENRY ELECTRICAL SOCIETY meets every other Friday evening between October and May. Headquarters, 115 West Twenty-eighth Street, New York City.

THE PACIFIC COAST ELECTRIC TRANSMISSION ASSOCIATION. President, W. F. Pierce; secretary, George P. Low, 427 Tenth Avenue, San Francisco, Cal.

AMERICAN STREET RAILWAY ASSOCIATION.—President, C. E. Sergeant, Boston, Mass.; secretary, T. C. Penington, 2020 State Street, Chicago, Ill. Next meeting, Chicago, 1899.

CHICAGO ELECTRICAL ASSOCIATION.—Meetings, first and third Friday of each month. from October 1 to June 1; J. R. Cravath, secretary, Monadnock Block, Chicago, Ill.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES.—President, R. R. Bowker, New York; secretary, Wilson S. Howell, P. O. Box, 114, Newark, N. J. Next meeting, 1899.

PENNSYLVANIA STATE STREET RAILWAY ASSOCIATION.—President, Robert E. Wright, Allentown; secretary, S. P. Light, Lebanon. Last meeting, Scranton, Pa., September 7-8, 1898.

NATIONAL ELECTRIC LIGHT ASSOCIATION.—President, A. M. Young, Waterbury, Conn.; secretary, George F. Porter, 203 Broadway, New York. Next meeting, New York, May, 1899.

NORTHWESTERN ELECTRICAL ASSOCIATION.—President, Henry L. Doherty, Madison, Wis.; secretary, Thomas R. Mercein, Milwaukee, Wis.

THE MARITIME ELECTRICAL ASSOCIATION.—President, F. A. Bowman, of New Glasgow, N. S.; secretary, J. H. Winfield, New Glasgow, N. S. Last meeting, Halifax, N. S., September 27-28, 1898.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS.—President, W. W. Ryder, Chicago; secretary, P. W. Drew, Milwaukee, Wis. Next meeting, Wilmington, N. C., June 19, 1899.

THE SOUTHWESTERN GAS, ELECTRIC AND STREET RAILWAY ASSOCIATION.—President, Carl F. Drake, Austin, Tex; secretary, E. L. Wells, Jr., Marshall, Tex. Next meeting, Austin, Tex., April 19, 1899.

THE OHIO ELECTRIC LIGHT ASSOCIATION.—President, Emil C. Schmidt, Sandusky; secretary and treasurer, Samuel Scovil, care of Cleveland Illuminating Company, Cleveland. Next meeting place, Cleveland, 1899.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION.—Dr. Francis B. Bishop, Washington, D. C., president; Dr. John Gerin, Auburn, N. Y., secretary. Next meeting, Washington, D. C., September 19, 20 and 21, 1899.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK.—President, G. Tracy Rogers, Binghamton, N. Y. Secretary, Henry A. Robinson, New York City. Next meeting, Ithaca, N. Y., September 12 and 13, 1899.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, New York.—President, Dr. A. E. Kennelly; secretary, Ralph W. Pope, 26 Cortlandt Street, New York. Meeting, fourth Wednesday of each month, from September 1 to June 1.

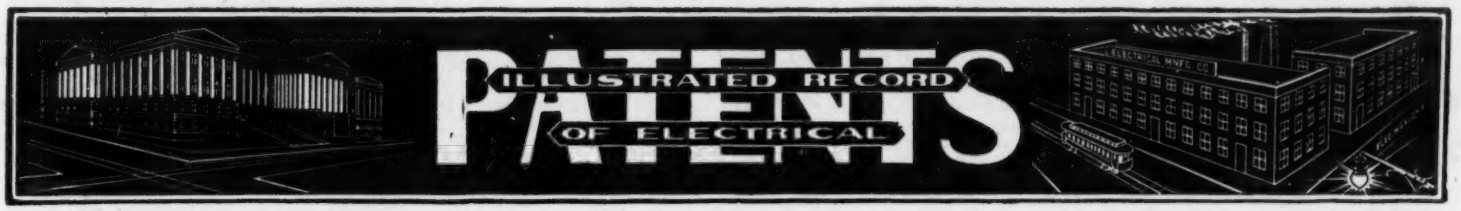
INDEPENDENT TELEPHONE ASSOCIATION OF THE UNITED STATES.—President, Judge James M. Thomas, Chillicothe, Ohio; secretary, W. J. Vesey, Fort Wayne, Ind. Next meeting, June, 1899. Place to be named hereafter.

ASSOCIATION OF FIRE AND POLICE TELEGRAPH SUPERINTENDENTS AND MUNICIPAL ELECTRICIANS.—President, J. W. Aydon, Wilmington, Del.; secretary, H. T. Blackwell, Jr., New York. Next meeting, Wilmington, Del., September 5, 1899.

THE BROOKLYN INSTITUTE OF ARTS AND SCIENCES, Brooklyn, N. Y. Henry T. Weed, secretary. Future meetings: March 3, illustrated lecture on "Electricity in the Navy," by Captain Zalinski, U. S. N.; April 7, lecture on "Cable Telegraphy," by A. E. Kennelly; May 5, lecture by Prof. William A. Anthony.

Business Notice.

"DAILY TELEPHONE ITEMS" is the name of a new paper, which has the unique distinction of having the smallest circulation and highest price of any paper published. It is compiled from clippings taken each day from 1200 papers read by Burrelle's Press Clipping Bureau, 32 Park Row, New York.



UNITED STATES PATENTS, ISSUED FEBRUARY 14, 1899.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

619,263. CARBON CLAMP FOR ELECTRICAL PURPOSES; J. F. Bachmann and A. Vogt, of Vienna, Austria-Hungary. App. filed October 8, 1897. In combination, an electrode, a conductor extending therethrough and secured directly thereto, a body of mercury confined within the electrode and surrounding said conductor, and means for securing a circuit wire to the conductor.

619,269. ELECTRICAL TRANSMISSION OF SOUND; F. M. Bell, of New York, N. Y. App. filed October 12, 1896. In apparatus for transmitting sounds, the combination of a sound receiver, a balanced beam arranged in operative relation with the sound receiver and carrying a resistance, a point contacting with the resistance, a lamp in circuit with the resistance, and a receiving circuit provided with a resistance variable by light.

619,287. ELECTRIC RAILWAY; J. B. Entz, of Philadelphia, Pa. App. filed January 5, 1898. Means for operating motor cars from each end of a train which comprise a train-conductor circuit or system, the identical controllers on each motor car provided respectively with devices for arranging the motors and train-conductor circuit or system in fixed combination on the rear car and with devices for cutting out the train-conductor circuit or system and reversing the motors on the front car, substantially as described.

619,296. DYNAMO-ELECTRIC MACHINE; S. S. Forster, of Schenectady, N. Y. App. filed November 14, 1898. The combination in a horizontal dynamo, of a spider with a split hub, and an integral collecting device secured to one side of the spider, with a space between the hub and the free side of the collector.

619,299. RETAINING BAND FOR COMMUTATORS; J. R. Grindrod, of Lynn, Mass. Filed November 5, 1898. As an article of manufacture, an assembled commutator wholly or partially finished, having a wire band for retaining the segments in place, a mechanical clamp for holding the wire in place, which is disposed at an angle to the plane of the segments, and depressed portions in the wire band for retaining the mechanical clamp in its angular position.

619,302. TWO-RATE METER; C. D. Haskins, of Newton, Mass. App. filed July 14, 1897. As an article of manufacture, a segmental contact plate provided with means for securing it to a dial and establishing connection with the supply circuit.

619,307. ELECTRIC MOTOR; T. D. Hollick and F. W. Hollick, of London, Eng. App. filed December 22, 1897. In electromotors and in combination, an armature shaft, two separate armatures, the main armature having a greater length than diameter, mounted thereon, and a field magnet movable with relation to the armatures to surround one or a portion of both armatures.

619,314. ELECTRICAL HEATER; C. W. Jones, of North Temescal, Cal. App. filed February 10, 1898. An electric heater, comprising a bottom plate, a bottomless plate secured centrally to said bottom plate, whereby portions of the plate project laterally beyond the box on the four sides thereof, a casing of greater horizontal and vertical dimensions than said box, surrounding the same and secured to the bottom plate, whereby a space is left between the box and casting at the sides and top of the box, a non-heat-conducting material in said space between the box and casing, electric-heating devices in said box provided with electrical connections, and insulating means between said box and bottom plate, substantially as described.

619,316. TROLLEY CATCHER AND RETAINER; W. B. King, of Willoughby, Ohio. App. filed November 26, 1897. In a trolley catcher, the combination with a frame open at its upper end, of one or more pivoted levers opening downward to receive the trolley and automatically closing upward to retain said trolley after it has been received.

619,320. TROLLEY; C. W. Larson, of Schenectady, N. Y. App. filed October 31, 1898. The combination of a plurality of trolley poles, each mounted on a rotatable base, an operating lever for each trolley and mechanical connections between the levers.

619,324. BATTERY SWITCH; R. Macrae, of Jersey City, N. J. App. filed August 18, 1897. The combination of a row of battery cells, a track extending parallel thereto and co-extensive therewith, a traveling contact device moving on said track, a continuous contact strip with which the contact device makes connection, a series of contact strips corresponding to and connected with the cells, with which the traveling contact device also makes connection, an endless chain connected with the opposite end of said traveling contact device and means for moving said chain to cause the traveling-contact device to move along the track, substantially as described.

619,360. INSULATING ALTERNATING-CURRENT CIRCUITS; C. P. Steinmetz, of Schenectady, N. Y. App. filed July 15, 1898. The art described of eliminating air from an electric apparatus to be subjected to alternating stresses, which consist in forcing out the occluded air by an insulating vapor.

619,406. RAILWAY SIGNAL SYSTEM; C. Hansel and P. Freeman, of New York, N. Y. App. filed October 19, 1898. In an apparatus, the combination with a signal and a lock therefor, of a locking disk connected to said lock an electromagnet, the armature of which engages said disc, a shaft on which the disc is mounted, a handle for turning said shaft in one direction and a ratchet connection between said handle and shaft.

619,410. TELEGRAPH-KEY ATTACHMENT; A. J. Hendricks, of Crockett, N. Y. App. filed August 30, 1898. The combination with a telegraph key, of a circuit-closing leaf spring, connected at one end with the anvil contact of the instrument, and provided at the free end with an upturned terminal normally exerting a pressure against the operating end of the key lever, a fixedly-positioned guide-bushing, a pull connection for the free end of said spring passing through said guide-bushing, and a controlling lever connected with said pull connection.

619,440. DUPLEX FARADIC BATTERY; J. H. Robertson, of New York, N. Y. App. filed April 9, 1898. The method of equalizing secondary currents by successively energizing, by means of intermittent primary currents, two electro-magnets alternately in circuit with an induction coil, an armature and a battery, substantially as described.

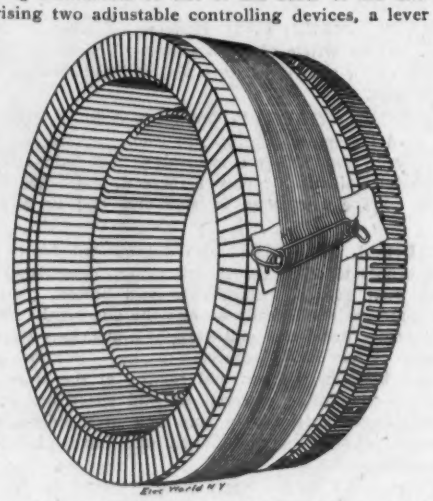
619,445. SWINGING BRACKET T. Smith, of Georgetown, Ill. App. filed July 29, 1897. A swinging bracket containing three substantially parallel arms, each one of which has a universal joint at each end, and is arranged out of the plane of the other two, substantially as described.

619,448. ELECTRIC BURGLAR ALARM; J. Tomney, of New York, N. Y. App. filed October 4, 1897. In an electric protective system, the combination of a plurality of electrical connections, forming a plurality of circuits between an indicating point and a guarded structure, a number of variable resistances located in said connections, and means for changing such resistances and the path of the circuit between the guarded structure and the indicating point, substantially as described.

619,449. ELECTRIC PROTECTIVE SYSTEM; J. Tomney, of New York, N.Y. App. filed June 24, 1898. In an electric protective system, the combination of a circuit, between the central office or indicating point and a guarded structure, the return for which is made through a plurality of patns, an indicating device, a source of electricity, and resistance contained in said circuit and means for including in the return of said circuit additional current and resistance, which resistance compensates for the additional current, said means also changing the return from one path to another, substantially as described.

619,456. ELECTRICAL SWITCH; A. Brier, of Manchester, Eng. App. filed December 13, 1898. In combination, a switch, a resistance comprising a movable part, operating means therefor, including a worm spindle, the movable bearings therefor and operating connections leading from the switch to move the said bearings, substantially as described.

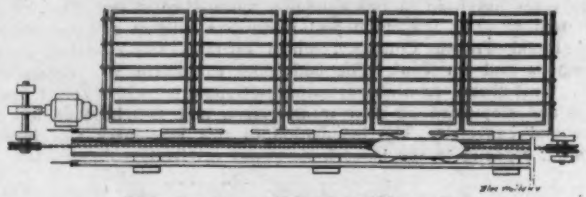
619,476. MECHANICAL TIME SWITCH FOR TWO-RATE ELECTRIC METERS; J. H. Gerry, of New York, N. Y. App. filed May 5, 1898. The combination of an electric meter operating mechanism, a plurality of dial mechanisms, mechanical switching means for mechanically connecting the meter-operating mechanism to one or the other of the dial mechanisms, a clock comprising two adjustable controlling devices, a lever engaging with both said devices, a wheel engaging with said lever, and means connected to said wheel for operating the mechanical switching device.



No. 619,299.—Retaining Band for Commutators.

619,493. TELEPHONE ATTACHMENT; F. Lind, Jr., of Paterson, N. J. App. filed September 20, 1898. The combination with a telephone receiver and switch hook or hanger, of an extension secured to a portion of the telephone instrument, a receiver support mounted on said extension and a lever fulcrumed on said extension and having a wiping engagement with the hanger, substantially as described.

619,555. TELEGRAPH INSULATOR; I. B. Franz, of Allenport, Pa. App. filed August 4, 1898. In an insulator for telegraph wires, the combination of a supporting pin, a fastening pin formed integral with and extending upwardly from the upper face thereof, a convex groove positioning plate for the wire having its upper surface formed with a series of positioning grooves adapted to be mounted on said fastening pin, extensions formed integral with the lower face of said positioning plates to prevent its movement when mounted upon the fastening pin, and an interiorly screw threaded securing cap adapted to be mounted upon the fastening pin to securely hold the wire and positioning plate in position, substantially as described.



No. 619,324.—Battery Switch.

619,620. ELECTRIC MOTOR; C. L. Rosenqvist, of New York, N. Y. App. filed April 4, 1891. An alternating or pulsating current motor, having two field-magnet circuits mounted upon a common core, and means for rectifying the current in one circuit to maintain a constant field magnetism, only one circuit being active at a time.

619,621. ALTERNATING-CURRENT ELECTRIC MOTOR; C. L. Rosenqvist, of New York, N. Y. App. filed June 19, 1893. The combination in an alternating-current motor, of a brush operating lever and a switch actuated by said lever and controlling the circuits of the synchronous portion of the motor, substantially as described.

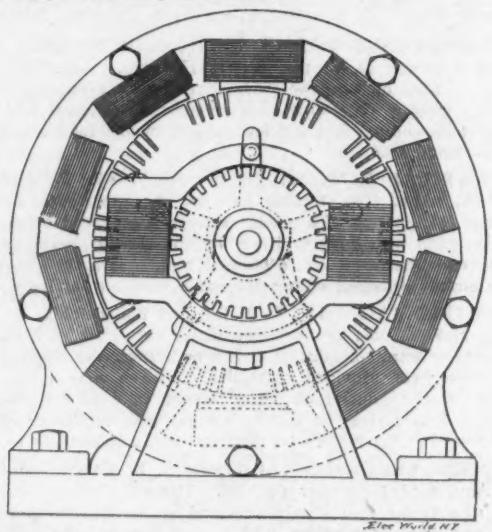
619,622. SECONDARY BATTERY; A. Schanschieff, of London, Eng. App. filed September 20, 1895. An active material for secondary batteries composed of a lead salt and a carbonized carbohydrate, substantially as described.

619,636. APPARATUS FOR SEPARATING MAGNETIC MATERIALS; O. A. P. Trustedt, of Stockholm, Sweden. App. filed July 31, 1895. In a magnetic separator, the combination with a series of electro-magnets, of a source of multiphase, alternating currents of which the windings of each phase are connected to different magnets in the said series.

619,662. TELEPHONE SIGNALING SYSTEM; D. M. Bliss, of Brookline, Mass. App. filed April 11, 1898. A telephone signaling system, comprising a local circuit at each station permanently disconnected from the main circuit, electromagnetic signaling mechanism in each local circuit, and a transformer at each station, said transformer having one of its coils in series with said local circuit and its other coil bridging the main circuit, substantially as described.

619,667. ELECTRIC PRINTING MACHINE; G. L. Lambert, of Dushore, Pa. App. filed October 30, 1897. An electric bulletin, comprising a frame having paper-carrying rollers mounted thereon and means for traversing the frame, positive means acting upon one of the paper-carrying rollers to rotate it, a spring-held locking means acting upon the other roller, and a lever adapted to engage the latter roller to give it a partial rotation, substantially as described.

619,679. GALVANOMETER; A. A. Dittmar, of Jersey City, N. J. App. filed August 27, 1898. A disc armature consisting of an iron spiral or snail forming the periphery of the disk and terminating at the centre thereof, and a spiral of non-magnetic material interposed between the convulsions of the iron spiral, the two spirals being brazed together to form a complete and rigid disc, substantially as described.



No. 619,621.—Alternating Current Electric Motor.

619,687. ELECTRICAL SIGN; W. A. Harvey, of Scranton, Pa. App. filed February 22, 1898. In an electrical sign, the combination with an insulating base, of a series of parallel conductors supported thereon, and a plurality of lamp holders, having grooved edges to engage the adjacent edges of any pair of conductors, substantially as described.